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Journal of the Society of Arts,
AND OF
THE INSTITUTIONS IN UNION.

111th Session.] FRIDAY, MARCH 17, 1865. [No. 643. Vol. XIII.

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Announcements by the Council.

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Ordinary Meetings.

Wednesday Evenings at 8 o'clock.

March 22.—"On the Preservation of Food, especially Fresh Meat and Fish, and the best form for Import and Provisioning Armies, Ships, and Expeditions." By G. C. Steet, Esq.

March 29.—"On Window Horticulture, and the Cultivation of Plants and Flowers in Cities and Crowded Localities." By John Bell, Esq.

Cantor Lectures.

The Third Course for the present Session will consist of six Lectures "On Some of the Most Important Chemical Discoveries made within the last Two Years," to be delivered by Dr. F. F. Crace Calvert, F.R.S, F.C.S. (Corresponding Member of the Royal Academy of Turin ; of the Société Industrielle de Mulhouse ; of the Société Imperiale de Pharmacie de Paris, &c.), on Tuesday evenings, at Eight o'clock, as follows :—

April 4th.—Lecture 1.—On the discoveries in Chemistry applied to Arts and Manufactures.

April 18th.—Lecture 2.—On the Discoveries in Chemistry applied to Arts and Manufactures (*continued*).

April 25th.—Lecture 3.—On the Discoveries in Agricultural Chemistry.

May 2nd.—Lecture 4.—On the Discoveries in Physiological Chemistry.

May 9th.—Lecture 5.—On the Discoveries in the Chemistry of Rocks and Minerals.

May 16th.—Lecture 6.—On the Discoveries in the Chemistry of Metals and Alloys.

These Lectures are free to Members (without ticket), and every Member has the privilege of admitting One Friend to each Lecture.

Musical Education.

The Committee appointed by the Council to inquire into the present state of Musical Education at home and abroad, consists of the following gentlemen :—

Wm. Hawes, Esq., Chairman of Council.
Lord Henry Gordon Lennox, M.P.
Lord Gerald Fitzgerald.
Sir John P. Boileau, Bart.
Sir George Clerk, Bart.
Sir John Harington, Bart.
Sir Francis Sandford.
Colonel Scott, R.E.
Capt. Donnelly, R.E.
Edgar A. Bowring, Esq., C.B.
Harry Chester, Esq.
Henry Cole, Esq., C.B.
Herbert Fisher, Esq.
Samuel Redgrave, Esq.

His Royal Highness the Prince of Wales, President of the Society, has consented to honour the Committee by acting as its chairman.

Proceedings of the Society.

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Cantor Lectures.

Second Course.—Sixth Lecture.—Monday, Mar. 13.

Mineral Veins, Ores, and Mining.

Professor Ansted commenced by stating that the last division of his subject included mineral veins, their contents, and the methods adopted to extract these contents. Metals are obtained either native or as crystalline minerals, called ores, from certain fissures and veins in altered rocks. The obtaining of ores from veins is metal mining. All rocks now above the water have been raised to their present position by some powerful upheaving force. They must have been dried before being elevated, and this involves contraction. Contraction and elevation must have produced cracks and fractures, whose nature depends partly on the rock itself, and partly on the mode of action of the moving force. It is not possible to conceive upheavals without fissures; but they are of two kinds, as due to two causes. Those caused by contraction will be governed by chemical laws. Those caused by upheaval will be regulated by the amount of force exerted, the weight to be lifted, the direction of the upheaving force, and the mechanical condition of the rock at the time of upheaval. The first kind may have begun as soon as the rock existed. The second kind commenced with the first upheaval. They may be due to a multitude of movements going on for a long time. During long periods such fissures may have remained unaltered. From time to time they may have been interfered with by other fissures. But cracks once formed, and then neglected, may have been filled up with fragments of the adjacent rock, or with crystals that have grown in the cavity. A crack in a mass of limestone may be occupied with calc spar. A wide fissure in such rock may be filled with rolled blocks of limestone. An empty space may have become filled with lumps of zinc or lead ore. All rocks present phenomena that have some resemblance to those of mineral veins; the formation is an ordinary event in nature. Crevices formed during the elaboration of a rock, are small, and filled up with crystalline material derived from the rock itself. The rock is purged of foreign contents by aid of these cracks, and by the facilities they offer for throwing off substances of which there is only a small proportion. But the filling up of crevices formed by contraction need not differ from the filling of wider cracks. The crevice must be formed before the filling up can begin, and thus every true crack must have defined walls. This distinguishes true veins from differences of condition and of mineral composition which belong to some process of segregation. The successive veins in slates and granites, elvans, bands in clays, and coloured lines and marks in sandstones, are of this nature. They are modifications of the rock, but not mineral veins. Of the two classes of fissures those produced during the formation of the rock are the simpler and the most common. All fissures in rocks, filled with crystalline minerals may be called mineral veins, but only those which contain valuable ores are lodes or metalliferous veins. The origin of the vein is of small importance, but its history is interesting, and will guide the miner in following the traces of the vein when it is lost sight of. Metalliferous veins in stratified rocks are chiefly confined to accumulations of lead and zinc ore and carbonate of iron in natural open spaces or caverns in limestone. It is difficult to explain this, but it is a law of nature, at least with certain limitations. Let us see what these veins are like, and what clue we can obtain to their history. Between and amongst limestones, where the bedding is regular, and cavities occur at the interval between two beds, there may be deposits of galena and calamine. These cavities communicate with others by crevices across and between the strata. How far the natural cracks may have been enlarged by subsequent upheaval, it is impossible to say, but the main deposits of ore often seem dependent on the stratification. There is little guide to the discovery of veins of this kind when lost, beyond a careful following of the clue afforded by a thread of ore. Useful mineral veins are the result of disturbances that are systematic, and they often correspond with the structure of the part of the country where they occur. Thus, in Cornwall and Devon there is a chain of granite bosses ranging east and west, and a quantity of slates, schists, &c., having a similar range. In the slates, schists, and granite are numerous metalliferous veins. Of these some are more regular, and better defined than the rest. Such veins are called master lodes or champion lodes. They are parallel to each other, and may be recognized as belonging to a system. These main lodes range in the same direction as the axis of elevation of the district. The general range of the local geological axis of the country being made out, then the direction of the main lodes are parallel to it, and the lodes of next importance at right angles to it. And this law is an expression of the fact that mineral veins are fissures in altered rocks, produced systematically by mechanical force elevating the whole district, and breaking up the rocks in a manner that may be estimated mathematically. If a rigid solid, tied down on all sides, be exposed to pressure from below, sufficient to overcome the tension of its parts, it must crack on yielding, and these cracks will follow certain laws. They must be parallel and at right angles to each other and to the elevating force. One important conclusion from this mode of considering mineral veins is, that in different countries the systems of veins must exhibit different directions. Thus, while the ore-bearing veins in Cornwall are east and west, in other districts they may be north and south. The direction of elevation must govern the formation of each system of veins. But if veins are due to disturbances that have acted at intervals during a long period of time, and not always in the same direction, the axis of disturbing forces may change, and there may be new systems of veins crossing older systems. Or successive elevations may produce complication in a different way, breaking up and heaving the mineral veins after they have been filled. Thus are produced faults and throws. In the determination of the law that governs the distribution of lodes, we should know the direction of the axes of elevation that have effected them, and the order of the occurrence of the disturbance. The fissures formed in rocks, whether on solidifying or whilst elevation was going on, must approximate rather to a vertical than horizontal direction. Thus mineral veins are often almost vertical, or if inclined they are so slightly and irregularly. But fissures in rocks are not lodes until they have been filled with mineral matters. These are usually crystalline. The filling up distinguishes the mineral vein from the open fault, or crevice, and the lode from the mineral vein. There is no reason why a fissure open at the top, or a crack formed during the construction of an ordinary fault, should not become filled with stones from above or from the walls. Occasionally the vein contains substances washed in by water from a distance. But when mineral veins are filled with spar the case is different. The material may have been carried in from above and deposited from water. In this way some veins in limestone contained in a solid mass angular and rolled lumps of limestone, galena, blende, calamine, and shells. The cementing medium is carbonate of lime, and the agent water. So it is possible that crevices open below have received minerals in the state of vapour. Of these sulphur and arsenic are familiar examples. The former is found lining the walls of cavities. In volcanic districts examples of this are common. Thus deposits from above, brought in with or without water, and deposits from below, with or without steam, are methods adopted by nature. But no one familiar with veins will suppose that all known cases can be thus explained. The vast majority of lodes are lined with crystalline minerals which have commenced to form on each wall of the vein, and not either at the top or lower part. When the deposit has begun, the crystals have accumulated symmetrically. Assuming that crevices have become converted into veins by chemical action within the rock, this either involves the conveyance of foreign material by water circulating through the veins, or the passage of this foreign material through the mass of the rock itself. Both are possible. Water circulates through all free spaces in the interior of the earth. It is often hot, and loaded with a variety of minerals. Hot water no doubt has been largely concerned in bringing various ores as well as earthy minerals into veins. The filling up of veins is a subject of the deepest interest to the miner. He would willingly discover a law by which he could convince himself of the existence of ore from the nature of the surrounding rocks, or from the surface appearance of the lode, or from the intersections of lodes with each other, or with some particular kind of rock; or from the degree of inclination of the lode. Such laws are not known, and it will be long before observations on these conditions justify absolute conclusions. But there is some relation between the contents of a lode and the conditions under which it has become filled. By observing facts, and studying their mutual relations, miners have found that a gossan or iron oxide at the top of a lode is an indication of a course of ore. The condition of the gossan is significant, some iron stones being recognized as favourable and some unfavourable. A "kindly gossan" is to a Cornish miner an indication of a valuable lode. So the fact that in lodes crossing each other, or in lodes traversing both granite and slate, there is generally a deposit of ore either at the intersection of two lodes, or at the point where a lode passing out of one rock enters another, must be regarded as tolerably well established. Little is known of the cause of this result. It may have been due to an electric or galvanic action, or it may have reference to causes altogether distinct. The study of the observations illustrating this rule cannot fail to be useful; but we are met by the difficulty of assigning a satisfactory reason for a phenomenon certainly very common. The condition of the enclosing rock is not without influence on the contents of a lode. An experienced miner will judge by reference to this of the value of an unworked vein. Certain conditions of softness in slate and granite are considered favourable, but a compact rock rarely contains large quantities of valuable ore. This applies to quantity rather than quality. Less important is the inclination of a lode. The valuable lodes of a mining district have certain mutual relations, but there is no clear identification of the cause. Certain metals and ores are common in lodes having one general direction, while other ores belong to other rocks and to cross courses. This is the case in all mining districts. In Cornwall the copper and tin lodes are usually in the direction of the axis of elevation, and are far the richest in ore; the lead veins are in the cross-courses, and are less important. In other districts, where the lead ores are in the main line of upheaval, the copper ores are of small amount, and occur in the transverse fissures. Mineral veins contain native metals, oxides, sulphides, or carbonates. Other combinations are less common and less abundant. All these are found in veins mixed with quartz, with crystalline salts of lime, and with clay, in large quantities. It is in mineral veins that the larger proportion of those combinations occur that seem to have little importance on the earth's crust, but that must certainly have uses and influence. Few metals and ores are sought with much care. The chief are, iron oxides and carbonates, iron pyrites, native copper, oxides, sulphides, and carbonates of copper, oxide of tin, sulphide and carbonate of lead and zinc, sulphide and oxide of silver, native gold and silver, native mercury, and sulphide of mercury. The metals and minerals of which the supply and nature are such that they are unknown in the general market are not here referred to. All ores are not found in abundance in the same district, in the same kind of rock, or in the same kind of vein. Certain laws exist, in obedience to which they may be looked for, and these laws must be ascertained by observation. What is true for Cornwall is true in principle, but not in detail, for Wales, for Chili, for Cuba, and Australia; and if the experience acquired in Cornwall is taken abroad, and there applied without consideration of the change of circumstances in the deposits, it will fail. Mineral veins containing ore are of very various dimensions. Of their length little is known. They are traceable in some cases for many miles at the surface, and below the surface they probably run on for far greater distances. It is difficult to say what is the inferior limit of length, for pipe veins and shoots are often in sets, and connected by narrow crevices. The width is more determinable than the length, and varies from a few inches to many yards. A silver vein in Mexico exceeds fifty yards, though not for any great distance. The width is sometimes increased by parallel fissures filled with ore, and threads of ore pervading the rock that encloses the vein. This condition of veins is a stockwerk, and lateral veins are called also strings. The depth to which mineral veins bear useful deposits of ore is unknown. Tin and gold have been supposed to abound near the tops of lodes more than at great depths but this is not likely. The tops of lodes often consist chiefly of quartz and iron oxide where the lode contains a large quantity of iron, with or without copper or other metals, and where the vein stone is siliceous. Veins in granite and slate are vertical or nearly so, and the same system of lodes generally shows the same underlie. In limestone they are often zigzag, mere gaps of small depth, or open spaces between certain beds of limestone and shale. There are certain associations of earthy minerals with metal. The sulphides of copper are generally accompanied by siliceous minerals. Rich ores of silver are often found in gneiss, with quartz, while silver-lead ores and galena are abundant in limestones. These general indications of habitat are useful, but they cannot be trusted in all cases. Owing to the nature of mineral veins and lodes, their hardness always differs from that of the enclosing rock. If harder, they stand out above the surface as walls; if softer, the top of the lode is more rapidly weathered than the walls, leaving a depression. In either case the lode is broken away, and carried along the surface by water. When left behind the heavier portions containing the ore will be accumulated in certain places, but in smaller quantities and smaller particles, as they are more distant from the lode. By following up from point to point the traces of a lode from these fragments, a miner will discover the position of the lode. This is called shoding. When a lode is reached it is necessary to prove its direction and underlie, its width, and its condition at various points of outcrop. For this purpose trenches are cut across the direction of the lode at certain points where it ought to be. These are called costeaning pits. These are generally the best means of discovery, without the outlay of much money and labour, and the lapse of a long period of time. Mining is speculative; and of all kinds of mining that which is most elementary, namely, the discovery of valuable lodes is the most speculative. At one time a trial and the expenditure of a few hundred pounds will lay bare a deposit of enormous value; at another, the utmost prudence and intelligence, with capital, will end in failure. Lead and zinc deposits in limestone are different from veins in granite and slate, and the search for lead is thus different from that adopted in reference to copper. Lead deposits are irregular, and the process of shoding adopted on the surface with regard to copper, is applicable underground for lead. In some lead districts, were the ore is found between bands of limestone, this method is applicable; Derbyshire is an example in point. It is not so in Flintshire and the Isle of Man, which are also lead-mining districts. Mining districts are to some extent indicated in a good geological map. They occur where rocks have been metamorphosed; where granites and slates and schistose rocks are found; where granite appears; where the contact of granite with sandy and clayey material is marked by changes in sands and clays, and where limestone is disturbed, we may look for fissures systematically grouped, and containing crystalline minerals and ores. The more remarkable of such districts are those in England, Cornwall and Devon. Derbyshire, Northumberland, and Cumberland are the chief mining counties for metalliferous ores in mineral veins. North Wales supplies lead and copper, and the Isle of Man is rich in silver-lead ore. In North Wales gold has been found. Ireland contains copper mines. Scotland contains lodes in its south-western counties. France presents five metalliferous districts. Belgium is rich in zinc and lead. Spain is exceedingly rich in most of the metals. Italy is very rich in iron and copper. Germany was the cradle and is the school of scientific mining, and the variety of minerals found there is very great. Silver, copper, lead, tin, cobalt, nickel, bismuth, antimony, and iron are all found there, and some under circumstances of extreme interest. Scandinavia abounds in iron and copper. In Russia there are many mining districts, and silver and lead are worked in the Altai mountains. Throughout Asia mining districts are known to exist; and the islands of the Southern Archipelago, as well as Australia, contain important supplies of useful metals. Both North and South America are metalliferous, and Central America still yields the chief supplies of silver. The native copper on the shores of Lake Superior is one of the most remarkable deposits in the world. When a lode is known to exist, and the indications justify operations, it is usual to sink a pit on it or cut it by a level or adit driven in from the nearest hill-side. If ore is found it may be run out from such an adit, and if water comes in it may be drained without cost from all workings above the point at which the adit cuts the lode. Assuming that the lode improves on going down, and justifies a farther outlay, a shaft is put down to cut it at some convenient point. At various depths cross-cuts may be made towards the lode to prove its position and the state of the ground and of the ore. All lodes are in their nature irregular. They contain what are called courses of ore, or they are bunchy and contain pockets of ore. The former condition is that of a deposit of ore uniform within certain limits of depth and distance, succeeded by barren portions. Experience has too often proved that there is no dependence to be placed on the presumed continuance of courses of ore in any direction. Bunches and pockets of ore consist of expansions of a lode filled with ore, or portions of a large lode exceptionally rich. Courses of ore occur not unfrequently in the great copper mines of Cornwall. Pockets of ore are most common in the lead-mining districts. Mining work includes—first, the removal of ore already discovered; secondly, the laying out, and bringing into a convenient state for extraction, the courses and bunches of ore already discovered; and, thirdly, the organising of trials and discoveries in those parts of the lode not yet proved to bear ore. Judgment is needed in laying out a mine so as to secure a supply of ore to pay expenses, retaining a reserve in the event of the supply failing, and expending a fair proportion of the profits in trial work. Owing to the irregularity of lodes, shafts must be put down to suit the condition of the lode. Thus slant shafts are sunk either from the surface or from some point below, and, by perpetually following the ore and removing it wherever there is sufficient to make it profitable, the works become extremely complicated. It is impossible to carry on mining operations on a large scale in mineral veins without timbering. When the vein is nearly vertical, it requires little timbering to prevent the walls from coming together, especially when the country is solid, and the walls clearly defined. But there are cases where the excavations are so large as to render timbering a very costly operation. Sometimes the waters of the mine tend to rot the timbers that are used to shore up walls, and keep the overhanging wall from closing in on the foot-wall. There is no objection to the use of gunpowder in blasting in metal mines. Judgment is needed in deciding on the position and depth of the bore-holes, to take advantage of natural joints in the rock, and remove large blocks. The plan of a metal mine is rarely systematic. But there is always one leading idea based on the method of removal of the water, and connecting this with discovery. Where the rainfall is large, the water that accumulates in a deep mine may become very considerable, as it comes in from above, from the sides where the lode connects with small branches and strings, and from below. It must be removed at the smallest possible cost; but, unless care is taken, the water lifted from one mine may find its way down another, or require to be lifted over and over again from the same workings. To avoid this, systematic drainage of groups of mines is desirable, and deep adits are cut, which receive the waters of a number of properties and convey them to a distance. In Cornwall the great adit receives the waters of the numerous mines in Gwennap and Redruth districts, and measures thirty miles in length. One branch penetrates ground seventy fathoms below the surface. The water thus conveyed is discharged into the sea forty feet above high-water mark. In the construction of long lines of deep adit, it is desirable to cross at right angles the direction of the principal lodes of the district. Metal mines are reached by ladders placed vertically in the shafts, but when the depth is great the descent and ascent become extremely exhausting, and waste time as well as strength. Of late years, man-engines have been adopted, by means of which the men can reach their work and leave it with comparative comfort. Man-engines are not needed for shallow mines, and would not be advantageous where the depth is less than 200 fathoms; below this the gain is very great. Almost all the mining work in Cornwall is executed by contract. There are two classes—the "tutmen," who excavate at a price per fathom of ground, and the "tributers," who speculate on ore ground when reached. Poor mines are worked by tut-work, but when good ore is reached the tutman engages to raise it at a certain price per fathom. In other cases the tributers come in and speculate. They agree to work a portion of the lode for a given time, receiving a certain agreed portion of the ores raised. If the ore be rich, they accept a small percentage of the value, if poor, they demand a larger percentage. The captains, having decided the value to the best of their judgment, put up a portion or *pitch* to auction, the bidding being downwards, and the parties who bid being each represented by one man. The ores are generally raised by machinery and broken at the surface. In addition to the quantity of rubbish left below there is thus generally a waste heap, or *attle*, at the pit-mouth. This is produced during the operation of *dressing*. Professor Ansted then gave a brief recapitulation of the general subject, and concluded with the following remarks:—Thus it is that geology, applied to the arts, is a subject of real and vital interest to all of us. In endeavouring to illustrate this, and interest you in the subject, I have confined myself as much as possible to familiar facts and exemplifications. I need not point out to you that to follow these generalisations into detail one must possess a very wide range of knowledge and great practical experience. These can rarely be combined in one person; and thus the agriculturist, the engineer, the miner, and the manufacturer must each learn his own department of practical geology, and apply it to his own purposes. The search after this knowledge is as interesting as the knowledge itself is useful; and the interest is increased when the student, before seeking out that which belongs to his own department, will make himself master of so much of the general subject as to see the bearings of theoretical views on all the details that come before him. There are other applications of geology that I have not brought under your notice in these lectures. Among them I would especially point out its application to the fine arts. I mention it now to remind you that the subject of applied geology is far from being exhausted; that, in fact, I have only considered it in one aspect, and that the many-sided science that deals with the earth, its history, its structure, its grand physical features, and the causes that have produced and are daily modifying them, is no less calculated to interest the artist and the poet than the farmer and the manufacturer. There is no limit to the study when we engage in the comparison of the works of Nature, with their application to the requirements of man, and the operations of man's intellect.

FIFTEENTH ORDINARY MEETING.

Wednesday, March 15th, 1865; Thomas B. Winter, Esq., in the chair.

The following candidates were proposed for election as members of the Society:—

Brandt, F. C. W., 3, Abchurch Chambers, Abchurch-lane, E.C.
Drake, Francis, Friar-lane, Leicester.
Jacobs, Lewis, 146, Strand, W.C.
Kiel, George Middleton, 16, Stanley-gardens, W.
Oakes, William Smith, Addison-road, Kensington, W.
Simes, N. Phillips, 58, Coleman-street, E.C.

Strachan, Mrs., Norfolk-house, Arundel-square, N.
Wilkin, Frederick, 10, Spring-gardens, S.W.

The following candidates were balloted for and duly elected members of the Society:—

Dibley, George, 72, Malden-road, Haverstock-hill, N.W.
Miles, Henry Thompson, 61, Strand, W.C.
Redman, Capt. Gabriel J., 6, Belsize-park, Hampstead, N.W.

The Paper read was—

ON MARINE ENGINES FROM 1851 TO THE PRESENT TIME.

By N. P. BURGH, Esq., Engineer.

The history of the origin of the marine engine, and its slow advance, has been so often written, that I feel assured I shall not cause much disappointment if I pass over that already worn-out subject. I propose, therefore, to introduce to your notice the marine engine as it was in 1851, and the improvements which have taken place from that period to the present time. As the present paper alludes to the year 1851, it will not be deemed out of place to describe briefly the marine engines shown in the Exhibition of that date. The screw propeller was then making but slow progress, consequently the attention of our engineers was diverted from straining their talents to produce more perfect arrangements. The following examples of marine engines were exhibited.

For the paddle-wheel, the engines were arranged as follows:—Vertical, angular or inclined, direct-acting, and oscillating; for the screw-propeller, a more varied and numerous collection was given, comprising disc, rotary; for horizontal direct-acting types, were the following, double piston-rod, return connecting-rod, trunk; after which, annular cylinder, vertical direct-acting, inclined direct-acting, single piston-rod; and, lastly, a beam engine. The largest pair of engines were 700 horse power collectively, horizontal, direct-acting, single piston-rod. The trunk engines were 60 horse-power collectively; these two examples were adapted for the screw. For paddle-wheels, the engines of the greatest power were a pair of 140 horse-power, of Belgian repute, the framing and paddle-centres being of wrought-iron, thus ensuring sufficient strength with a reduction of material and weight. To describe each engine in detail would be tedious, as well as of little value to the engineer of the present day. Allusion to the defects and improvements will be found under the different descriptions of the necessary appendages.

I will now proceed with a brief notice of the marine engines exhibited in the year 1862, when it will be seen that a great improvement had taken place between the two dates alluded to. We are, I am happy to state, still making an advance, and I trust to be able this evening to describe these improvements; but, at the same time, I beg to suggest that there is plenty of room for further improvement in the detail of marine engines, which, doubtless, will be ere long taken into consideration by those interested in these matters.

In the year 1862, our International Exhibition was again held, and with much success as far as regards marine engines. The class exhibited showed great improvement, both in design and arrangement. The oscillating engines adapted for the paddle-wheel did not exhibit much alteration, although it cannot but be said that in detail a change for the better was perceptible. With reference to the engine adapted for the screw, a complete revolution had taken place since the Exhibition of 1851. Valves and gear were altered, starting gear simplified; positions of condensers, air pumps and valves, in a much more correct state; number of details lessened; and, in fact, the entire arrangement fast approaching to a nearer state of perfection, viz., accessibility to all the parts in action without disarrangement. The following is a brief account of the writer's observation of the class of marine engines exhibited:—The paddle engines were vertical and inclined, oscillating, of the ordinary type and arrangement. The valve gear was of two kinds—the counter-balanced eccentric, and the ordinary link motion. The air pumps were worked by eccentrics in some instances, and in others by cranks. The mode of starting was by the ordinary ratchet or wheel and pinion—the bilge and feed pumps were, in some cases, worked by the oscillation of the cylinder, and in others by separate eccentrics. The means for disconnecting were of the disc and the drag-link kinds. Paddle-wheels were exhibited with fixed and feathering floats. Five examples of oscillating engines were exhibited, including models and drawings. The engines for the screw propeller were as follows:—One pair of double trunk engines, having injection condensers with an improved arrangement of air-pumps and valves. The double piston-rod return connecting-rod type was well represented; this arrangement is used on account of the great length of stroke and connecting-rod attainable in a given space. In the Exhibition now alluded to there were six pairs of engines of this class, with injection condensers and air-pumps of the ordinary arrangement, and one pair of engines with the improved arrangement of condensers, pumps, and valves. The single piston type of engine was not largely represented —one pair with the improved injection condenser, pumps, and valves, and one pair with those of the ordinary kind. The single trunk arrangement was represented by one pair, with single-acting trunk air-pumps in the condensers. The air-pump trunk with double piston-rods return connecting-rod engine was shown by drawings only. Vertical direct-acting engines were represented thus—one pair with annular cylinders, double piston-rods, and injection condensers of the ordinary kind; one pair with single piston-rods and surface condensers; and another pair as the last, with ordinary condensers.

It will be understood that in the previous examples the cylinders were arranged in pairs, the cranks being at right angles. In order to obviate the strains imposed at the extremity of each stroke, one firm exhibited engines with three cylinders, with spur gearing for reversing, stopping, &c., which were termed the expansive and economical principle. Lastly, I allude to the writer's invention "Burgh and Cowan's patent antifriction trunk engine," so arranged, that the friction of the trunks is dispensed with, and no area lost in the cylinder. This arrangement was represented by a pair of engines and drawings. Having thus briefly alluded to the marine engines exhibited in the two International Exhibitions of 1851 and 1862, I will now proceed to give a detailed description of each portion.

The arrangement of marine engines in the hold of the ship is, perhaps, not generally thought to be of so much importance as it really is. It should be strictly understood that the attention required for engines of river steamers bears no comparison with that required for marine engines; imagine a ship in a gale, and heated bearings, and a faint idea can be formed of the duties required, and the reason for a free access to all the working parts.

For the purpose of illustration to those present, not professional engineers, I will briefly specify what the necessary component parts of a pair of marine engines of the present day consist of, viz., cylinders, pistons, slide valves, piston rods, slide casings, expansion valves, blow-through valves, piston rod guides, connecting rods, cross-heads, main frames, crank-shaft, eccentrics, rods, links, valve rods, guides, condensers, air-pumps and valves, injection valves, snifting valves, discharge valves, bilge and feed-pumps, valves for the same, starting gear, and turning gear, lubricators, and all the necessary levers, bolts, nuts, &c. It will thus be seen that marine engineers have more difficulties to contend with than is generally known. To understand the use and real character of each of the above details is not the work of weeks or months, but years. It should not be forgotten either, that the honour of our nation, and the lives of its representatives, are often in the hands of the marine engineer. I will now proceed with the descriptive illustration of details, showing defects, improvements, and suggestions for the future, commencing with slide valves.

These valves govern the entrée and exhaust of the steam to and from the cylinders. Two kinds or classes of valves are now universally used, the common and the equilibrium; the former is so well known that a description of it is scarcely necessary. I will only observe that its use for larger engines is much on the decrease, on account of the stroke of the valve being due to its outside lap, which for large ports is considerable. Equilibrium valves are so called from the equal action of the steam tending to lift the valve from, as well as to press it on its facing. These valves are double-ported to reduce the stroke. One firm has lately introduced three-ported valves, to still further reduce the stroke. In order to reduce the friction of the valves on the facings, rings are used encircling the body of the valve, adjustment being gained by screws, ratchets, and springs to prevent looseness. In some cases a communication from the back of the valve to the condenser is arranged, to still further reduce the pressure on the valve facing. Slide rods are usually one to each valve, but latterly two have been introduced for large valves, which no doubt greatly assist in guiding the valve during its action.

The next portion in rotation will be that for working, reversing, and stopping the action of the slide valve, universally known as the "valve-link motion." The date of the origin of this motion is doubtful. Mr. Zerah Colburn, in his new work on locomotive engineering, tells us, however, that 1832 is the earliest period of its application for locomotives. Marine engineers introduced it firstly for oscillating paddle-wheel engines; afterwards for fixed, horizontal, and vertical engines adapted for the screw propeller. The object of the link motion is to reverse the action of the slide valve without disconnection. The links now in use are of two kinds—slotted and solid. The slotted link has the sliding block within it, whereas that of the solid kind slides within the block. The means adopted for raising and lowering the link are various. One maker prefers to use a lever, secured on a weigh-shaft, passing over the front part of the cylinders, motion being given by a worm and wheel, the former being keyed on or forming part of the starting wheel shaft. Another firm deems it better to impart motion to the lever by a ratchet and pinions. A third authority raises and lowers the link by a rod connected to a block surrounding a coarsely-pitched screw, motion being given to the screw by mitre gearing; whilst another firm prefers to fix the block, with the screw to be elevated and lowered. These two last are undoubtedly the most powerful of the examples given.

The systems at present adopted for guiding the slide valve rod are of three kinds. First, the dove-tailed guide, similar to that used by tool-makers for the arm of a shaping machine. Secondly, a block of gun metal sliding on two fixed turned rods as guides over and under the valve rod. Thirdly, the valve rod secured to a square bar, working in a bracket, and cap to correspond. This last may be said to be the most simple, but perhaps not so rigid as the first example. The double guides are complicated, but at the same time produce the rigid resistance to the strains imposed on the valve rod by the vibration of the link.

Some makers of marine engines prefer to allow the link to rest or hang on the block pin inserted in the lever of the slide rod weigh-shaft. Such a practice dispenses with guides. Excessive vibration of the link on or in its block greatly deteriorates the action of the valve, it being understood that whilst the link has an ascending or descending motion, as well as sliding, the strain on the valve rod is increased, and at the same time the stroke is effected. The excess of the vibratory motion is painfully perceptible in the ordinary slotted link; the eccentric rods being connected beyond the block pin, a direct-action cannot ensue. The distance between the centres of the eccentric rods and block regulates the amount of indirect action. Links of this kind are often hung from a rod connected in the centre to the link, either to the clip or at the back. This is far better than at the lower end, as the connection of the suspension rod regulates the ascending and descending motion of the link whilst at work. The link resting on the block when for going a-head, obviates to a certain extent some of the evils alluded to. The gain by the introduction of the solid link, with the eccentric rods connected at its extremities, is strength with less material, but the vibrating motion is not decreased. In order to obtain a more direct, and, if possible, a perfect action, the eccentric rods have been secured to the link, so that the centre of connection may be on that of the block, and by this the vibratory motion is effectually got rid of. There have been two distinct modes for accomplishing this, which I have had the opportunity of observing. The first example is—two solid links, one on each side of the block, the eccentric rods being connected to pins on the outer face of each link, the inner face and sides being sustained in a groove in the block, which oscillates on its axis, in the eye of the valve rod, the links being one on each side. The second example is like the first in principle, but one solid link only is used, of a dove-tailed form in section, at the inner face, to prevent the link from slipping out of the groove in the block; the eccentric pins are fixed in the extremities of the link, and the rods are attached as in the last example, but with a single eye. The writer has designed a solid link and connection, which, although not superior in principle of action to the two last examples, is more simple in construction, and has less working portions; therefore it may be held to be worthy of introduction. A solid bar of iron is slotted at each end, to receive the single eye of each eccentric rod, so that the entire surface of the link remains unbroken; it is secured in a block with an adjusting portion and key at the back, the front being open sufficiently to admit of the ascent and descent of the eccentric rods; adjustment in front can be attained by loose portions and set-screws, but this last is not imperative, as the wear of the link and block is very slight when the acting eccentric rod is on the centre of the block; the block has provisions on each side for suspension, the valve rod having portions formed to receive the block; the back part of the rod works in a dove-tailed guide of the ordinary kind.

It now becomes necessary to treat of the suspension or lifting rods for solid links; for this a few words will suffice. As the ascent and descent of the link whilst in motion are governed by the length and position of the rod, it is almost needless to state that the suspension rod should be connected in the centre of the connection of the eccentric rod. The link, when for going a-head, should be down. It may now be argued that the vibration of the link, when for going astern, must be excessive. Granted; but as the forward motion of the ship is of the most importance, it is not unfavourable to economy to adopt the connection alluded to. In some cases the solid link is guided at the top or bottom, but this is only required when an overhanging or outside connection of the eccentric rods is resorted to.

The next portion for consideration is the expansion valve and gear; the use of this valve is to allow the steam to be cut off at the early or given part of the stroke of the piston, and the expansion or elasticity of the steam completes the power required. Now it is certain that the use of high pressure steam for large cylinders and short strokes, produces excessive shocks at the commencement of the strokes, and thereby entails an increase of strength in the materials used, so that the proportions are larger than when for ordinary purposes. It is clear also that, when steam is admitted at an excessive pressure against the piston suddenly, it (the piston) receives an impetus equivalent to the power imposed, and in no case whatever could an engine of proportions for low pressure resist the strains imposed by the use of high pressure steam. The ordinary pressure adopted by marine engineers is from 20 to 30 lbs. per square inch, more often the former than the latter. I am not aware, however, of any cause why 60 to 80 lbs. should not be adopted, with a great increase of economy and power. Of course the present proportions of engines and boilers would have to be increased, if the same materials were used, but steel boilers, shafts, and rods might be introduced with considerable advantage, embracing great strength with less weight.

Having alluded to the ordinary pressures at present used, it will be well now to advert to the expansion valves. These valves are of three kinds—throttle, slide, and tubular.

The motions imparted to the throttle valve are oscillating and revolving, the latter is now most generally adopted, but with this disadvantage, that the action is equal both for supply and cutting off.

The slide valves are of the ordinary and gridiron type, the latter may be said to be the better, on account of the stroke being so short in comparison to that of the former.

Tubular valves are tubes inserted in each other, with ports to correspond, a sliding or rotary motion accomplishing the desired effect. The motions imparted to these several valves are generally uniform, either by mitre gearing or eccentrics, consequently the action of the valves is not perfect. The proper motion for an expansion valve is to open gradually and close suddenly; to obtain this the old but correctly working cam must be resorted to; this useful arrangement is too often discarded to make place for newer but less correct productions. It may of course be urged that the cam is not applicable for high velocities, but undoubtedly its use might be attained by introducing stiff gear and perfect equilibrium double beat valves; by dividing this valve centrally a more correct action can be attained, in relation to that of the steam, on the valve whilst closed and open. The merits and demerits of the expansion valves here alluded to are almost equal. The ordinary throttle-valve has less friction than any yet introduced, but it possesses the great evil of throttling the steam when closing; also when this valve is worked by levers, or has a vibratory motion, should the stroke be lessened, the full area cannot be attained. The last evil is dispensed with in the remaining example, as the ports or openings are much larger than required when the valve is at full stroke, and not too small when the least motion is given. The friction of the gridiron iron valve is perhaps in excess of the other examples, as in the case of the tubular valves the action of the steam is neutralized. The means adopted for altering the grades of expansion valves whilst in motion are various. A spiral motion is the one universally adopted, and there is not the least doubt it is correct.

I will now call attention to the following description of an expansion valve and gear which I have designed for high velocities:—A cylindrical casing has within it projections at given positions; two of these projections act as spaces between the ports of ordinary tubular valves. The valve now explained is tubular, but the area centrally is half of that of the ends, which are parallel for given lengths, due to the stroke of the valve. These parallel lengths also regulate the neutrality of the valve whilst in action. At the present time the means adopted to impart the motion is a disc of metal with a circular slot; within this slot is a brass nut into which is screwed a pin. The connecting rod of the valve is attached to the pin in the ordinary manner. The means for altering the grades of expansion is by loosening the pin by its handle, and allowing the nut to slide in the slot to the required position. It is almost needless to add that the steam enters at the side of the casing, and escapes around and through the valve, keeping it in equilibrium.

The valves next in requisition are those for the ends of the cylinder, commonly known as relief valves. The usual kinds adopted are discs, with springs or weights to resist the given pressure of the steam. The action of these valves is, of course, due to the excess of pressure within the cylinder over that of the resistance caused by the springs or weights. It has been proved that in the case of excessive priming of the boilers the cylinders are suddenly flooded; in order to release the water, cocks are sometimes used, but in many instances the springs or weights are lifted by levers. Now, in the case of cocks, if not provided with valves beyond them they must be worked by hand at each return stroke of the engine, or the vacuum will be destroyed. The spring valves will close naturally, or by the spring on its release from the hand lever. High-pressure steam has been lately introduced, with great advantage, in the place of springs, but with an entirely differently-arranged valve and casing.

I have arranged a relief valve, so that the spring is not tampered with by levers or hand power, and an instantaneous opening can be effected without cocks, &c. The spring valve has an opening in it centrally to receive on its outer side a flat disc, termed the vacuum valve. On the inner side is a provision mitred to receive a solid disc valve, which, on being pressed inwards by a spindle and lever, allows a free exit for the steam and water; on a vacuum being caused the vacuum valve, which is guided on the spindle alluded to, closes the opening air-tight; by this it will be understood that the spring has not been in requisition, but on closing the inner disc the spring valve becomes one of the ordinary kind. Previously to starting the engines it is well known a vacuum should be caused in the condensers, also the cylinders and slide casings should be warmed, and the condensed water be allowed to escape through the relief valves or cocks.

The valves used for the purpose alluded to are termed the "blow-through valves." It may be here observed that, in some cases, the ordinary plug cock is preferred for this purpose. When valves are introduced, they are generally of the ordinary disc kind, but one firm adopts a common slide valve for the purpose, with the advantage of simplicity of levers, &c., and easy manipulation.

The piston-rods of marine engines are subject to excessive strain; consequently, the use of guides is imperative. For the single piston-rod engine, the universal system is a channel underneath the rod, the guide-block being generally of gun metal, and the upper portion attached to the piston-rod by bolts and nuts. For double piston-rod engines, the guides are of two kinds: the first arrangement is as the last, and the second, as for high-pressure engines, or double guides. To say which is the preferable mode of arrangement of guides will, perhaps, be deemed bold, but I may venture to state that I deem that for the single piston-rod the best of any yet introduced.

I cannot close this portion of the present paper without alluding to the admirable arrangement for tightening the gland of the piston rod stuffing-boxes, introduced by the firm of Messrs Maudslay, Sons, and Field. The screws are of the ordinary kind, but, in the place of nuts, worm wheels are used, worms being fitted to correspond; and motion can be given by a box-spanner while the engines are at work. This is one of the most important improvements tending to accelerate the progress of a ship during a voyage, say three or four months. Imagine the engines requiring stoppage during a gale in order to tighten the glands, and a fair estimation can be formed of the value of the improvement alluded to.

Having commented, though somewhat briefly, on the cylinder appendages, attention may now be given to the main frames and crank-shaft. The main frames may be said to undergo a continuous strain, and must, consequently, be of a certain strength in order to preserve the requisite rigidity. The cylinder is attached to the one end, and the condenser at the other, whilst the crank-shaft has to be supported in its bearings. Not many years ago a celebrated firm used to make the condenser and main frame in one casting: since that, we have had the well-known frame like the letter A laid on its side, also the hollow frame, with a raised projection for the crank-shaft, and a stay from the upper portion connected to the cylinder; this last may be said to be the most simple, and, at the same time, of less material than the A frame. As before stated, the strains on the frames are continuous, yet, when sudden shocks occur, from the racing of the engines or priming of the boilers, the tenacity of the cast-iron is severely tested. As this is the case, wrought-iron might be used with great advantage, both as to increase of strength and decrease of weight. The crank-shafts of marine engines are generally of wrought-iron, in one mass, the cranks being double, and forged with the shafts. Three bearings are deemed imperative, so as to equally distribute the strains. Now, this is correct in theory and practice, and the writer will be deemed committing a grave error no doubt, in mathematics, when he assumes that the forward frame and half-crank can be dispensed with, in order to reduce the weight and material. He is, of course, aware that the thrust and pull of the connecting-rod will be thrown on the centre crank and bearing, but, in order to counteract this, the length and diameter of the shaft at that part should be increased. He would also prefer, in this case, to extend the frame and connect the upper portion to the condenser; the cap being on the top instead of at the end, as now used. Screws might be employed to adjust the side brasses; the eccentrics could be within the cranks, or between them and the bearings.

Having alluded to the principal working details, I will now lay before you a description of the mode of condensation—past and present. It is well-known that the principle of condensation is to convert the steam into its original state. The contact of the cool fluid, in the shape of water, accomplishes this in the ordinary condenser, and cooling surfaces in the surface condenser.

In the days of the introduction of side lever engines, the arrangement of the condenser and air-pump was faulty; in some cases the foot-valves were almost inaccessible. Not many years ago, being on board a steam-ship fitted with old side lever engines, which were then undergoing repair, I noticed a rope and block tackle over near the condenser. On inquiring of the engineer how he progressed, the answer was, "I am just going to sling one of the men with this tackle, by the heels, to inspect the foot-valves; and that," said he, "is no foolish job." On further examining the engines, I found that an upside-down attitude was required, and indeed the only one allowed for the inspection of the valves in question. Happily now, however, such an inconvenient arrangement is of rare occurrence. We also find the side lever engine is being superseded by that of the oscillating type.

The arrangement of the ordinary condenser and air-pump for oscillating paddle-engines is generally as follows: the condenser is situated between and below the trunnions of the two cylinders; the air-pumps are at an angle, with trunks and connecting rods of the ordinary kind; the foot-valves are at the bottom of the barrel of the pump, the piston has valves in it; and the discharge-valve, when not at the top of the pump-barrel, is at its side. Now, the principal defects in this arrangement are in the position of the valves and condenser. When the foot-valves are directly underneath the pump's piston, it is obvious that an almost entire disconnection must be made to inspect them. Also, in the case of the piston-valves requiring inspection, the pump-cover must be removed, and to attain this the gland packing has to be slackened, and the connecting rod disengaged. Now, to avoid these evils, doors might be introduced, but with these disadvantages—increased height or length of the air-pump passages, and a body of water always above and below the piston, which undoubtedly is what any right-thinking engineer would disapprove of, it being clearly understood that an air-pump will produce a better vacuum when the piston thoroughly discharges the contents between the foot and delivery-valves at each stroke.

Having thus pointed out the existing evils of the ordinary arrangement, it will not be deemed out of place to introduce a remedy. The condenser at the side of, or below, the pump is in one of the worst positions that can be conceived; the idea of allowing the condensed steam to fall, only to be raised again, seems, on consideration, to be foreign to the ideas of our talented engineers. It is well known that, in ordinary arrangements, the condenser is always in the position alluded to; steam even of a low pressure is larger in volume, but not as dense and heavy as water; it is also more elastic, hence it will more readily ascend. This, then, being clearly understood, it is not unwise or impracticable to assume, that if the condenser were on the top of the air-pump, instead of at its side or bottom, a better vacuum would be maintained. I beg to offer a description of an arrangement of condenser and position of the valves, both for correct action and accessibility. It will be understood that the condenser in this case is over the air-pump; the suction-valves are inverted, consequently the weight of the water assists the action of the piston in causing a vacuum. The exhaust-steam from the cylinders rushes up the exhaust-pipe, and enters on the top of the condenser. The water in the air-pump is discharged through the delivery-valve, at the top of the pump, and from thence through the delivery-valve at the ship's side. A door is secured opposite the delivery-valve, and doors are provided on each side below the bottom of the condenser, for the double purpose of inspecting the suction-valves and the air-pump piston.

This arrangement of condenser and air-pump will occupy as little room as those of the ordinary kind, with the advantage of accessibility to all the working parts without disarrangement. It may be argued that the stuffing-box, being in a recess when used for guides, would be troublesome to keep tight or repack, but if oil be always kept in the recess, so as to entirely cover the gland, it would tend to lessen the liability of leakage; the nuts of the gland and bolts could be adjusted by a box-spanner, or the bolts prolonged to the top of the condenser. In cases where the depth of the ship would admit, the recess could be dispensed with; trunks are not proposed for this arrangement, as their diameters would be necessarily increased, owing to the length required to pass through the condenser, unless a recess were resorted to as now proposed.

The next portion of the subject now before us is the ordinary condenser for screw engines. The action of the air-pump in this case is usually horizontal, consequently the valves are at right angles to the pump. To describe each arrangement of condenser and air pump that have come under the writer's notice would occupy too much time, consequently a brief mention of two or three examples on this occasion will be deemed sufficient. For direct-acting and trunk engines, with the cylinders secured together or side by side, the condensers were between, and, in some instances, in front or at the sides of the air-pump. The foot and discharge valves were directly over each other, the former under the pump at each end, the condensed water or steam being drawn through the foot valves and forced through those above. In another instance the foot and delivery valves were extended the entire length of the air-pump and passages, the position of the valves over and under being as before, and the condenser being between the air-pumps. For return connecting rod engines, the condenser and air-pumps are subject to great disadvantages. In order to obtain a passably good arrangement, and, at the same time, occupy a moderate space in proportion to those last mentioned, the condenser, &c., have to be shaped to suit the purpose required. It must be perfectly understood that when the piston rods are beyond the crank shaft (as in the examples now in question) there is a certain amount of space required for the piston-rods and guides of the cross head, or guide block, whichever may be used. It is also clear that accessibility to all the valves without disarrangement should be attained. To illustrate these desiderata the following examples will be sufficient for the present purpose:—In one instance the condenser is partially between the cylinders, and extending beyond the crank shaft; the air-pumps are at the side of the condenser; the suction-valves extend the length of the air-pump; and the discharge valves are between each pump, the pump and the valves being beyond the crank shaft.

The next example is as follows:—The condenser and its appendages are entirely beyond the crank-shaft. The air-pumps are at the extremity or sides and near the bottom of the condenser. The foot and discharge valves extend the entire length, and are arranged over and under the pumps in the usual form. The guides for the piston rods are between the upper portion of the condenser and that of the discharge chamber.

Having disposed of the principal arrangements of air-pumps and condensers as formerly constructed, allusion will now be made to those of recent improvement and practice. As before stated, a better vacuum can be attained when the condenser is over the air-pump instead of at the side. For direct-acting engines there are two arrangements specially worthy of notice. 1st. The air-pumps are worked by the steam-pistons between the cranks as near the base lines of the engine as the periphery of the circles will admit, the condenser being one chamber, directly over the air pumps. The suction valves are inverted in the bottom of the condenser, so as to effectually drain the same. The discharge chamber extends the entire length on each side and back end of the condenser, the valves being nearly in the same line as those for the suction, but reverse in action. The next example is the same as the last in principle, although different in arrangement. The air-pumps are situated as in the last example, but the condensers are separate, one to each engine, over and on each side of the air-pump. The suction valves are inverted in the bottom of each condenser to obtain the advantage before alluded to, the discharge chamber and valves being central or between each condenser, and directly over and between the air-pumps. It may now be argued, that if the two examples last mentioned are perfect in action and arrangement, what is the cause of the diversity? The answer to this is, Diversity of idea. Engineers, as a rule, are averse to the act of copying from each other. No sentence grates more harshly on the ear of a scientific man than the words, "Where did you copy this," or is more repugnant to his dignity.

Having referred to the improvements in the arrangement of condensers, &c., for direct-acting engines, attention will now be given to those adopted for double piston-rod engines. It must be borne in mind that for this class of engine the prolongation of the piston rods beyond the crank-shaft greatly deteriorates the arrangement of the air-pumps and condensers, in relation to the space occupied by those for single piston rod engines. In the examples now given, the air-pumps are worked by the steam piston, and as near the base line as possible. The condensers are separately arranged outside the guides of the piston rods of each engine; the suction-valves are inverted above the top of the air-pump, as in the last examples; the discharge chamber is between the air-pumps and the valves, on the same level as those for the suction. It will thus be understood that both suction and delivery are at the side, over and extending the length of each air-pump, instead of being directly over them, as in some cases.

The next example worthy of notice is arranged as follows:—The condensers and their appendages are beyond or outside the guides of each engine, the air-pumps deriving their motion as in the previous examples, and are as near the base line as possible, so situated as to clear the guides. Partially over and beyond the side of each air-pump are the discharge valves, above which is the discharge chamber; over this, and at the side of the same, is the condenser with the suction valves inverted.

I will now allude to the system of condensation known as surface condensation. Mr. Hall, in days of yore, introduced the tubular arrangement with great advantage. Engineers at that time were slow in appreciating the then presumed gain, and it is only lately that we have seen the surface condenser universally adopted by the powers that be. To condense steam properly is undoubtedly to reduce it to its natural or original state. Now, in the ordinary condenser we bring water into actual contact with the steam to condense it. Surface condensers are to be recommended, particularly for one reason, viz., the production of distilled water for the feed of the boilers. The arrangement of the tubes in surface condensers entails practical difficulties as to the position most suitable, whether they be inserted transversely, perpendicularly, or longitudinally, of the hull of the ship, renewal of the tubes being often required (sometimes while at sea) from corrosion.

The means adopted to render the connection of the tubes in the plate air-tight are numerous. The usual mode now is — india-rubber rings recessed in the plates encircling each tube — compression being obtained by a nut for perpendicular tubes, and by the vacuum in the condenser for those of horizontal positions; —this is simple and efficacious, and at the same time economical. It must here be remarked, however, that compression of the india-rubber by vacuum can only be attained when the steam is condensed by the external surface of the tubes or within the plates. The circulation of the water is either through or surrounding the tubes, and is produced by pumps with plunger-piston or centrifugal action. The position of the piston-pumps is horizontal, motion being derived either from the steam-piston or piston-rod. The centrifugal-pump requires a separate engine, or spur-gearing, &c., from the crank shaft to give the required velocity.

The values of the two arrangements now used for the condensation of the steam are about equal. In the case of the water surrounding the tubes, the steam passes through the same, and in the case of the steam surrounding the tubes the position of the water is reversed.

It is obvious that where internal condensation is effected a greater number of tubes are required, in relation to those of the external system—the inner surface of the tube being less than that of the outer. The advantage gained by the steam entering the tubes may be said to be—access for cleaning without disarrangement. Injection, or ordinary condensers, are more generally used than those of the surface kind, on account of economy in the outlay of capital at the commencement.

The injection-valves for ordinary condensers are generally of the solid or gridiron type, the latter to reduce the stroke to open and close. The pipe for the dispersion of the water is usually a tube, with apertures, of an elongated or circular form. An improvement has lately been made in these pipes, by contracting the area for one-half the length, thus equalizing the diffusion of the water throughout.

The next valve necessary for the condenser is the snifting valve, which is a single disc of gun metal, with a slight spiral spring at its back, or upper part. A screwed spindle is universally used to prevent the valve from rising, after the water and air in the condenser has been blown out previously to starting the engines. It might be deemed neglectful if I were not to make allusion to the bilge injection-valve or cock, whichever may be used. This valve, as well-known, is only required in cases of necessity, such as leakages, or disarrangement of the bilge or donkey pumps. I would beg to suggest that the bilge water should not be allowed to enter the condenser, on account of the generally impure state of the bilges. A valve and box might be arranged at the end of the air-pump for this purpose.

The portions of the marine engine next for exemplification are the feed and bilge pumps. The position of these is so arranged that a free access can be obtained to the valves and surrounding parts without disarrangement. Some makers prefer to work the feed and bilge pumps in a line with each other, with one rod and plunger direct from the steam-piston. Other firms secure the pumps side by side to the discharge water-pipe of the condenser, each plunger being connected to the piston-rods crosshead; this latter improvement is more general than the former. In the case of hollow plunger or trunk air-pumps, those for the feed and bilge are on each side of the air-pump. and secured by nuts or keys. Before terminating this portion of the subject, it will be well to add that the valves for the air, feed, and bilge pumps are now univeraslly discs of India-rubber, instead of the gun-metal spindle-valves.

It will have been observed that no allusion has yet been made to the arrangement of combined high and low pressure engines. For the purpose of comparison I will allude only to those arrangements in common use. The position of the low-pressure cylinders is side by side, as for those of the ordinary kind; in some cases annular cylinders are used, viz., the high-pressure cylinder within that for the low pressure. Another arrangement is the high-pressure cylinder on the top of that for the low pressure. A third arrangement has the smaller cylinder at the back end of the larger. A fourth example consists of two high pressure cylinders in front of one for low pressure, the former acting as guides for the piston-rod. The means adopted for imparting the motion of the piston to the cranks are of the ordinary arrangements already described, with the exception of the necessary extra piston-rods and stuffing-boxes.

Having alluded to the different engines, and their details past and present, adapted for the single screw, I will now call attention to a notice of arrangement of engines as at present used for the twin or double-screw system. It must here be mentioned that the class of engines now under notice have precisely the same duty to perform as those before described, consequently, if I pass over the major portion of the detail it is to avoid repetition.

The arrangement of the engines is usually separate for each screw. The type of engine generally adopted at present is direct-acting with surface or injection condensers. Single piston-rod engines. seem to be more in favour than those of the double piston-rod return action type, I presume on account of the simplicity of the former. The position of the arrangement in plan is side by side—port and starboard—instead of directly opposite each other; this is owing to the space required for the arrangement adopted, and the small beam of the vessel; but in some cases engines are arranged opposite each other, with a great reduction of space compared to that of the side system. When the crank shaftings are connected the steering principle is destroyed, and the twin screw system, so far as regards propulsion, is very little better than the single system.

There is not the least doubt that as a mode of steerage the twin system is correct, and for shallow draughts it is advantageous. To suppose the plan to be universally correct for large vessels requires, however, more practical evidence than I at present possess; but of this I am confident, that for small or large vessels, whether for commercial or war purposes, the twin screws, when driven separately, are invaluable for steering. The advantages for war ships are principally the facility for manœuvring when under an engagement. Let it be presumed that the enemy has aimed at a twin-screw steamer, by a contrary action of the screws her position can be shifted instantaneously, and the intended evil postponed, if not averted.

I have come to the end of my brief description of the marine engine, and will now allude to the weight of material, cost of marine engines, and the relation of nominal to actual horse-power, together with the consumption of fuel. The variation in the weight of marine engines is due to the design and arrangement as much as the material used. Double trunks may be said to be a fair example as to the average weight of marine screw engines. Return connecting rod engines are perhaps the heavier, in comparison to those of the single type, in relation to rods and guides. High and low pressure engines combined are the heaviest of any examples yet given. The materials comprising the different portions of the engines of the present day are of six kinds—first, cast-iron, of which is formed the cylinders, pistons, valves, casings, main frames, guides, condensers, &c.; secondly, wrought-iron, comprising cranks and shaft, piston and valve rods, links, levers, weigh-shafts, bolts, nuts, &c.; thirdly, steel for springs, small pins, &c.; fourthly, gun metal for bearings, guide blocks, bushes, glands, nuts, &c.; fifthly, copper, for pipes of all kinds required for steam and water; sixthly, india-rubber, for valves, packing, &c. For the present occasion, in reference to weight, I have selected twelve examples of marine screw engines, each varying in power and design. The examples of arrangement being in pairs, the result has been that 4·334 cwt. per nominal horse power may be taken as the average weight of material, exclusive of boilers, fittings, screw-propeller, and alley-shafting. It may here be observed that each maker of marine engines in the present day differs in design and arrangement, consequently the weight of trunk engines by different makers would be unequal. The same may be said for single piston rod engines, as well as for double piston rod return connecting rod engines.

I now come to that portion of this subject which is the crowning question of all, and too often the cause of much controversy in political and commercial circles, viz., what is the cost? My opinion is, that it is perhaps the most difficult query to answer that could be put, and the only reason for its introduction is to preserve myself from presumed neglect in not noticing this important matter. To ascertain correctly which is the cheapest class oi engine at present in use, is a problem much too difficult for me to solve; but I will, however, tender such information as I deem reliable.

The price of a marine engine depends entirely on the class of workmanship. Should a roughly-finished engine and boiler be required, with more painted than polished surfaces, the cost will be reduced in comparison to that of the more highly-finished. The fittings also greatly regulate the outlay. Some companies pride themselves on this portion of display, others, again, look on it as an unnecessary expense; so, to draw a correct line of comparison would involve the amalgamation of the many ideas in order to give a fair evidence. I feel confident, however, that marine engines, with boilers and fittings complete, can be produced of certain classes, for £70 per horse-power nominal, and the same can be reduced to £50 per horse-power, each price of course being under certain conditions as to terms and workmanship.

Allusion must now be made to the power, &c., of marine engines. Nominal power is a term used particularly for commercial purposes. Each maker has his private rule, hence the difference in dimensions in engines of the same class and power. Actual horse-power is defined by the indicator diagram, speed of piston, &c.; the ratio between the nominal and actual power is in some cases low, in others high. The writer has known instances where, the nominal power being 1·0, the actual was 6·0; and in others, nominal 1·0, actual 2·123; the average ratio at present is nominal 1·0, actual 4·0 to 5·0. With reference to the consumption of fuel, there is a great difference in the evidence. Superheating and surface condensation are slowly making progress, and at the same time reducing the consumption of fuel in ratio to the amount of water evaporated or steam used. The average actual horse-power expended per cubic foot of water evaporated is, water being 1·0, actual horse-power 2·635 to 4·0, and doubtless in some cases more. The ratio of fuel consumed in lbs. per hour, to the actual horse-power per hour expended may be taken as follows:—Engines of ordinary construction, power, 1·0; fuel, 5 to 6. For expansive working-engines, with superheating and surface condensation, thus:—Power, 1·0; fuel, 2·50.

I am deeply indebted to several eminent firms for

TWIN SCREW PROPULSION.—TABULAR STATEMENT OF SHIPS, MARINE ENGINES, &C., CONSTRUCTED BY MESSRS. DUDGEON, BLACKWALL, SINCE 1851 TO THE PRESENT DATE, SUPPLIED BY THE FIRM.

Beam of Vessel.	Length.	Depth.	Tonnage.	Immersion.	Nominal horse power.	Diameter of cylinder.	Length of stroke.	Kind of condensor.	Diameter of air-pump.	Diameter of screw propeller.	Pitch of screw propeller.	Distance between centres of propellers.
ft. in.	ft. in.	ft. in.	tons.	ft. in.		inches.	inches.		inches.	ft. in.	ft. in.	ft. in.
22 6	150 0	13 0	395	9 0	120	26	21	Injection.	8½	7 0	14 6	8 9
23 0	165 0	13 6	425	,,	,,	,,	,,	,,	,,	7 5	,,	,,
,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,
,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,
34 0	225 0	22 0	1,258	17 0	150	H. 24 L. 50	24	,,	12	8 10	16 0	11 8
25 0	175 0	15 0	531	9 6	200	34	21	,,	11	8 3	16 0	10 5
23 0	165 6	13 0	425	9 0	120	26	21	,,	8½	7 0	14 6	8 9
,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,
,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,
,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,
11 10	57 6	7 0	35	4 10	30	12	11	High pressure.	None.	3 8	7 4	4 6
23 6	200 0	13 4	546	9 6	200	34	21	Injection.	11	8 0	16 0	9 5
15 0	85 0	6 6	91	2 9	30	12	11	High pressure.	None.	3 6	7 4	4 6
,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,
34 0	265 0	28 0	1,500	16 0	350	H. 31 L. 62	24	Surface.	11	10 6	18 0	12 0
17 0	100 0	6 6	138	3 6	30	12	11	Injection.	5¾	4 0	7 6	5 4
32 0	160 0	13 3	737	10 0	200	34	21	,,	11	8 0	16 0	9 5
24 6	200 0	13 4	592	9 6	,,	,,	,,	,,	,,	,,	,,	,,
28 0	250 0	15 6	972	10 0	300	40	22½	,,	13	9 2	17 3	10 9
,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,
27 0	230 0	14 6	829	9 6	250	37	21	,,	12	8 9	16 0	10 0
21 6	190 0	13 0	436	10 0	120	26	21	,,	8½	7 0	14 6	8 9

TABULAR STATEMENT OF MARINE ENGINES CONSTRUCTED BY MESSRS. JOHN PENN AND SON, GREENWICH, SUPPLIED BY THE FIRM.

Screw Engines.

	Minotaur.	Achilles.	Warrior.	Black Prince.	Resistance.
Diameter of cylinder	104¼	104¼	104¼	104¼	70¾
Length of stroke	4 ft. 4 in.	4 ft. 0 in.	4 ft. 0 in.	4 ft. 0 in.	3 ft. 6 in.
Revolutions per minute	—	52½	54¼	51¾	68 to 69
Diameter of screw	24 ft. 0 in.	24 ft. 0 in.	24 ft. 6 in.	24 ft. 6 in.	18 ft.
Pitch of ditto	25 ft. 6 in.	25 ft. 6 in.	30 ft. 0 in.	30 ft. 0 in.	21 ft.
Nominal h.p.	1350	1250	1250	1250	600
Indicated h.p.	—	5746	5471	5146	2424
Speed of ship	—	14·25 knots	14·35 knots	13·31 knots	11·84 knots
Date of trial	—	Dec. 28, 1864	Oct. 17, 1861	Aug. 30, 1862	Sept. 23, 1862

Paddle-Wheel Engines.

	Exploratore.	Taliah.	Izzeddin.	Victoria.	Prince Imperial.
Diameter of cylinder	72 in.	72 in.	66 in.	58 in.	52½ in.
Length of stroke	5 ft. 0 in.	5 ft. 0 in.	5 ft. 0 in.	4 ft. 6 in.	4 ft. 0 in.
Revolutions per minute	40	39	41½	42	48 to 49
Diameter of axis of wheel	19 ft. 0 in.	19 ft. 0 in.	17 ft. 6 in.	17 ft. 6 in.	14 ft. 11 in.
Length of floats	10 ft. 0 in.	10 ft. 0 in.	10 ft. 0 in.	7 ft. 10 in.	8 ft. 0 in.
Depth of ditto	4 ft. 6 in.	4 ft. 6 in.	3 ft. 10 in.	3 ft. 6 in.	3 ft. 2 in.
Nominal h.p.	350	350	300	220	180
Indicated h.p.	2556	2540	2373	1640	1480
Speed of ship	17·27 knots	17·74 knots	16·5 knots	16·83 knots.	16·3 knots
Date of trial	May 6, 1863	Dec. 28, 1863	Sept. 19, 1864	Sept. 3, 1861	Sept. 28, 1864

The following is a list of engines constructed by Messrs. Maudslay, Sons, and Field for H.M. Navy since 1851 to the present date, kindly furnished by Joshua Field, Esq.:—

		Horse-power Nominal.
Engines, &c., for 75 Screw Vessels	Total	37,570
,, 26 Paddle ,,	,,	6,340
,, 69 Screw Gunboats	,,	4,260
Total		48,170

The following Table gives Particulars of some of the Principal Marine Engines, recently constructed by Messrs. R. Napier and Sons, Glasgow.

NAMES OF VESSELS.	Paddle or screw.	Material.	Tonnage. O. B. M.	Kind of Engine.	Number of cylinders.	Diameter of cylinder.	Length of stroke.		Nominal horse power.	Kind of Boilers.	Kind of Propeller.
						inches.	ft.	in.			
Coromandel ……	Screw	Iron	—	Plunger, direct.	2	50	2	6	250	Tubular.	Common.
Gunboat for H. E. I. Co.	,,	—	—	Horizontal, high pressure.	2	18	1	6	80	Tubular.	,,
Emperor Alexander ………	,,	,,	—	Plunger, direct.	2	60	3	0	350	—	,,
Islesman …………	,,	,,	$197\frac{81}{94}$	Horizontal.	2	$24\frac{1}{8}$	3	0	80	Tubular.	,,
Victoria ……….	Paddle	Iron	$144\frac{76}{94}$	Oscillating.	2	$27\frac{1}{16}$	3	0	44	,,	Radial.
Fifeshire …………	,,	,,	—	Inclined.	2	$36\frac{1}{8}$	3	6	82	Lamb's flue.	Eccentric.
Chevy Chase ……	,,	,,	$963\frac{3}{94}$	,,	2	$72\frac{1}{8}$	8	0	416	Tubular.	,,
Royal William …	Screw	Wood	—	Plunger, direct.	2	$65\frac{1}{8}$	3	0	500	,,	Griffiths.
Cormorant ………	,,	Wood	—	Plunger, direct.	2	$45\frac{1}{8}$	2	0	200	,,	Griffiths.
Scotia ……………	Paddle	Iron	$4050\frac{28}{94}$	Side lever.	2	100	12	0	1000	,,	Radial.
Orestes……………	Screw	Wood	—	Plunger, direct.	2	$60\frac{1}{2}$	3	0	400	,,	Griffiths.
Clan Alpine ……	Paddle	Iron	$1507\frac{30}{94}$	Inclined.	2	64	8	0	400	,,	Eccentric.
Wolf ……………	,,	,,	870	,,	2	61	6	0	275	,,	,,
Rolfe Krake ……	Screw	,,	$1091\frac{13}{94}$	Horizontal direct.	2	48	2	0	235	,,	Griffiths.
Osman Ghazy……	Screw	,,	$4221\frac{51}{94}$	Horizontal direct.	2	92	4	0	900	,,	,,
Abdul Aziz………	,,	,,	$4221\frac{51}{94}$	,,	2	92	4	0	900	,,	,,
Orkman …………	,,	,,	$4221\frac{51}{94}$	,,	2	92	4	0	900	,,	,,

Total number constructed by this firm, from 1851 to 1864 inclusive—Screw engines, 87; Paddle engines, 39.

their courtesy and the practical information received and personally given. Messrs. John Penn and Son, of Greenwich, have kindly given me a tabular statement of much value to the profession and the Society. I am advised by this firm that a more extensive list of their trunk engines may be found in the *Artizan* journal for March, 1859, and November, 1861. The list now presented commences from the latter date; also that with their class of engines the consumption of fuel is about 4lbs. per actual horse-power per hour for those of ordinary construction, and about 2·5 lbs. per actual horse-power per hour for expansive engines, with superheated steam and surface condensation. This firm has displayed a warm interest in the present paper, by kindly lending the photographs and splendid working models, which I have the pleasure of laying before you.

Messrs. Maudslay, Sons, and Field have kindly lent photographs of their late improvements in marine engines. From personal interviews, I am enabled to present the Society with valuable information, particularly as follows:—The amount of fuel consumed, per horse-power actual, for ordinary engines by this firm is 5lbs., in some cases less and in others more. For three cylinder expansive engines, with surface condensation and superheating, the consumption is reduced to 2·25 to 2·5 lbs. per horse-power actual. These engines cut off at one-seventh of the stroke producing an almost correct indicator diagram. In one example shown me, the nominal horse-power was 150; with a pressure of steam 25 per square inch, the indicator diagram produced a result of 875 actual horse-power, being in the ratio of 1 to 5·833, which may be said to be an exceptional result for screw engines. This firm has constructed, since 1851 to the present time, the following number of engines and boilers:—Of screw engines, 183; of paddle-wheels, 30. The highest nominal power of one pair of engines yet constructed by this firm is 1,350, and the lowest 10.

The Messrs. Rennie have kindly lent me models and photographs of the different classes of engines they are in the habit of constructing. I am informed by this firm that the consumption of fuel for ordinary engines is — Actual horse-power 1, fuel 5. In the case of surface heating, surface-condensation, and expansion—Actual horse-power, 1, fuel consumed 2·5; showing a reduction of 50 per cent. on that of the ordinary kind, which is about equal to the other firms.

Valuable statistics have been supplied to me by Messrs. R. Napier and Son, of Glasgow, giving particulars of the ships, engines, &c., constructed by them from 1851 to the present time. From these I have made a selection for publication. This firm has also kindly presented me with splendid photographs of their engines, &c., which are hung for inspection.

With reference to twin-screw propulsion, I am deeply indebted to the firm of Messrs. Dudgeon, of Blackwall, they having kindly furnished for this occasion practical statistics of the proportions of vessels and engines constructed by them since the year 1851 to the present time.

In conclusion, I must apologise for the length of my present paper; but I beg to observe, that had I extended my remarks to twice or thrice the present length, I should even then have failed in doing justice to this subject, which is undoubtedly one of national importance. To the credit of those concerned it can be truthfully said, that, in comparison with other nations, the productions of our marine engineers maintain that high standard for excellency of design and workmanship which has ever characterised the natives of Old England.

DISCUSSION.

Mr. J. Clarke said allusion had been made to surface condensers, which, he presumed, would render unnecessary the use of salt water in the boiler, inasmuch as the boilers could be charged with fresh water before leaving the port, and this was used over and over again. He was recently in the workshop of a member of the Society, who was largely engaged in the manufacture of salinometers, having then a large order to execute for the Government, but in the event of the universal adoption of surface condensers, he presumed that instrument would be superseded.

Captain Jasper Selwyn, R.N., said, as a naval officer interested in the progress of mechanical invention, he thanked Mr. Burgh for the information he had afforded in his interesting paper. He would remark, in the first place, that only very slight mention had been made of boilers; but a man who took the interest, as Mr. Burgh evidently did, in mechanical questions, would never ignore the source of the power, or deem it unworthy of a place in his paper; for it was clear, so long as we went on with ineffective arrangements to produce the power itself, it mattered little how much economy was introduced into the arrangements for utilising the power. The steam boilers of the present day he considered to be a reproach upon the marine engineers of this country. They were very far from producing at any time anything like the results in practice which they produced when sent on trial trips. That was partly caused by the insufficient means of securing the circulation of the water in the boiler, and partly by the bad arrangement of the fuel for firing, by the choking of the tubes with smoke, and by the galvanic action which was speedily set up, and resulted in the deposit of large quantities of material all over the heating surfaces. In many ways the boilers required, but had not yet received, the same amount of attention that had been given to the engines. He thought improved means for securing the circulation of the hot water, and of preventing escape, of utilising fuel, and obtaining complete combustion, were of more importance than any improvement in the engines. He had heard of the introduction of steel with great pleasure, knowing how advantageous it would be in many respects; but if those who employed steel did not consider the electrical action which would result when that metal was brought into contact with copper, a deposit would be produced in the boiler which would go far to neutralise the other advantages. He was very pleased to hear incidentally introduced into the paper a subject in which he had for some years taken an interest, viz., that of twin screws. He was, however, at a loss to conceive on what ground it was said that the twin screw principle could only succeed in vessels of a certain size, and was not applicable to larger ships. No later than the previous day the newspapers gave an account of the trial of a vessel of 970 tons, fitted with twin screws, and the results, he had been informed by persons who were present, were correctly reported. Now, that vessel represented what would formerly have been called a large ship, and the question to be decided was—to what tonnage were the good effects of twin screws to be limited? In the first instance it was said that the principle was a good one for boats; and last year Mr. Rennie stated it had been tried with excellent effects in small river steamers, but he doubted the success of its application to anything beyond that. Subsequently to that, however, blockade runners, fitted with twin screws, made their appearance, and were completely successful, and since then the experiment had been tried on a still larger scale by ship-builders on the Thames. He deprecated such a decision being arrived at on this point as would prevent us from building vessels for our navy of such steering power as Mr. Burgh had recognised in the twin screws; besides this advantage, he (Capt. Selwyn) maintained there was also an increase of speed. They had a certain draught of water in a screw ship to which they were limited; they might put into the ship engine power as much as they pleased, but they could only utilise the area of water which came against the propeller. If they could increase that area they got more duty done by the engines without "churning" the water, and that was the whole theory of the success of twin screws in giving speed. That principle was perfectly applicable to a ship of war; and the vessel to which he had previously referred had another valuable quality: she gave, with a draught of nine feet six inches, a speed of 16¾ knots with both screws working, and of 12 knots with one screw only working. This showed that even in that vessel the power of propulsion was not utilised to its full extent; the increased velocity did not correspond to the increased horse-power used. With regard to the observations in the paper as to the reluctance of men to copy, he confessed he thought that class of intellect was more rare which knew how to judge properly what to copy, than that which invented for itself a new mode not always better than that which preceded it. The great masters in painting had numberless followers, who called themselves the scholars of those men; and it was no less a credit to these to have chosen well their master than to have produced something original. With regard to the comparison of fuel consumption, it must be recollected, when they got indicated h.p. in proportion to nominal h.p., as 4 or 5 to 1, and the coal burnt was now 2¾lbs., instead of 8 or 9lbs. per h.p., there was not so very great an advance as might be inferred from the way in which the case had been put. Much more might be done in the way of economising fuel, by due consideration of the best way of placing the heating power advantageously in the boiler. It was clear, so long as they did not provide for the free descent of the hot water when it had given off its steam, and had become to a certain extent cool—the free descent from the top to the bottom to be re-heated, so long they lost the good effect of the boiler. The injurious effects of scale in boilers had been obviated to a certain extent by the employment of scale catchers or surface apparatus for laying hold of the scale as it floated up, but he thought the better way was to consider any system which formed less scale in the boiler, and with that view fresh water when once in the ship might be maintained in the boiler without trouble. They could produce sufficient fresh water for the purpose by the utilisation of a small quantity of fuel so as to supply whatever waste of water took place from condensation. With regard to the general arrangement of engines in ships, he quite entered into the graphic illustration in the paper of a man hung by his heels to inspect the foot valves. He thought engines were made too much like watches. Engineers prided themselves on the small space within which they could place their engines, and by that means subjected the persons who worked them to a great deal of unnecessary inconvenience.

Mr. Rochusson, as one practically connected with the manufacture of machinery, would express his dissent from the statement of the last speaker—that the contact of steel and copper in a boiler would generate a stronger galvanic current than that of iron and copper.—[Captain Selwyn said he had made no such statement.]—There was no doubt that steel was a very important element in all engines, and he regretted that subject had not been more dilated on in the paper; at the same time, it was well to give a caution as to the indiscriminate adoption of steel for boilers. Steel would bear a higher tension that the best Yorkshire iron, but certain qualities of steel were unfit for boilers from their liability to injury from blistering. The most suitable form of steel for boilers was cast-steel, which could be made of a strength equal to a pressure of 60 tons to the square inch. One great object sought in engines was the avoidance of heated bearings; and the more they reduced the surface of the bearings, and the more they employed metal capable of a highly polished surface, the less were they liable to this evil. The use of cast-steel for shafting was, therefore, a great advantage. It had been found by experience that a cast-steel shaft of nine inches diameter was equal in strength to one of 11 inches in wrought iron. In that proportion, therefore, they saved material in the weakest part of the ship, and they had a stronger construction with less strain upon the engine. They might go from that to cast-steel propellers. There was scarcely a greater annoyance on a voyage than the breaking of a propeller. In one short voyage in one of his vessels, no fewer than five cast-iron propellers were broken. They were not, perhaps, at that time quite up to making good cast-steel propellers, but he believed they were so now. The first cost would be greater, but that was more than compensated by the safety and durability which were insured.

Captain **SYMONDS**, R.N., reverting to the subject of the twin screw, said that Mr. Burgh, while giving credit to that system for a certain number of advantages, had omitted two or three of the most important. During the last five or six years he had seen something of the practice of the larger class of twin screw vessels, and it struck him that one of the principal advantages of the twin system was that in the event of one engine or one screw becoming injured, they had the use of the other engine and screw, by which two-thirds of the power could be obtained in case of emergency. This was exemplified in the trial of the vessel alluded to by Captain Selwyn, when one of the engines being stopped, owing to heated bearings, she was propelled at twelve knots with the other engine; her full speed being rather over sixteen knots. That was a very important thing, especially in a merchant ship, as had been proved in a voyage to America. A twin screw ship had been able to proceed with fair speed and slight consumption of fuel with one engine, while the other engine was being repaired; so that when she arrived out her engines and boilers were in a good condition to run the blockade without any occasion for delay. If that ship had had only one pair of engines applied to a single screw it would not have been so capable of performing this service. With respect to the limit of size of ship to which the twin system was applicable, his gallant friend Capt. Selwyn's remarks on the subject rendered it unnecessary for him to go over the same ground again, but he would add that it was of the utmost importance to have the twin system adopted in heavy ships in order to divide the power between two engines, which ordinary engineers would then find no difficulty in manufacturing; besides, it was found difficult on board ship to lift out the heavy parts of very large engines for repair. He submitted also that the moving parts of these large engines in heavy ships were not so convenient as lighter machinery would be. Another great point was the difference in the amount of friction between the heavy single screw engines and the lighter engines on the twin system. In addition to these advantages, there was that which was derived from the position of the twin screws, away from the centre of the ship, which not only gave them a great advantage in propulsion, but also placed them away from the extreme end of the dead wood, where, from the longer leverage, greater vibration would necessarily be produced. In fact, the single screw produced an amount of vibration which was avoided in the twin screw system. Experience had shown that the twin principle had been applied with the best results to vessels of various sizes up to 500 tons, and within his own knowledge one of these vessels had been doing regular work in towing for the last six years. With a draught of only 3 feet 3 inches, and engines of 30 horse-power, she had been continually towing four Dutch barges, with loads of 50 tons each, at six knots an hour, which was a result, he believed, seldom obtained by paddle-wheel tugs of the same power and draught of water. The engines were in as good a state as when they were first built, and they had never been known to hang on the centre, which was one of the objections to the single screw engine. He had found the twin system effective for two main reasons. In the first place, the arrangement of the inverted cylinder engines on the A frame occupied no more room in the ship than a pair of ordinary screw engines, with this further advantage, that it did away with even the slight vibration which was found in vessels of the same character with the engines laid horizontal. He submitted these were points of advantage which ought not to be lost sight of

Mr. G. F. **WILSON**, F.R.S., remarked that on the first introduction of surface condensers a difficulty was experienced, which he should be glad to hear had been obviated. It was found that the oil used for lubricating certain parts of the engine was carried with the water into the boilers, and there, as was well known to chemists, when oil and water were brought together at a high temperature, the oil became separated into its acids and base, the acids being free to act upon the material of the boiler, and upon any impurities contained in the water. This was found to be an important objection to the surface condensers. He should be glad to know whether that objection had been removed. In addition to this the steam was not generated so quickly. It was proposed at one time to use oil not composed of acids and a base, such as mineral oil, which, it had been thought, would not be decomposed by the action of the water, but he had no means of knowing whether this succeeded or not.

Mr. **JOHN GRANTHAM** remarked that the double screw system had entered somewhat largely into this discussion. It was a subject of great interest at the present time, and the naval officers who had addressed them had spoken encouragingly of its advantages. There were to this question, as to all others, two sides. The system seemed to be a very captivating one, but he thought its advantages had been somewhat overrated, and they must be cautious not to take up too readily the few examples, which had been presented under perhaps the most favourable circumstances that could be obtained, and to suppose that the system therefore had all the merits which those particular vessels were shown to possess. The builders of those ships understood their business well, and built fast vessels to which they applied the twin screws, and we did not always weigh carefully how the great success had been produced, and whether the same results, or nearly the same, might not have been produced by the single screw. It was, therefore, not unnatural that naval men, who had to do principally with ultimate results, should be very much taken by these experimental vessels, but he feared, when they had had longer experience, some of those advantages would smooth down. As yet there was no proof that two screws would propel a vessel better than one, all other things being equal. He admitted that, if they had a vessel of light draught, and put very high power into it, probably two screws would show a better result than one, from the fact that they gave a larger surface under more favourable circumstances for propelling the vessel and utilising the power given to her. But he asked the engineers and naval men present to consider all the circumstances of the case. If they wished to have a screw vessel of light draught and great power, the double screw might be best; but if they were not limited as to draught of water and did not require excessive power, the single screw would be best. One disadvantage of the twin screw system was that it made the interior of the ship more difficult to deal with than when there was only one shaft and one set of machinery. If they could apply all the power favourably to one screw, he thought it desirable to do so. It would not, however, do to dogmatise on this subject; and, whilst he would not advise them to neglect this question altogether, he would caution them against thinking the system possessed all the advantages which had been urged in its favour as having been exhibited in the very fast and well-built vessels which had been recently brought before the public.

Mr. W. **HAWES** confessed his surprise at the observation of one of the naval officers who had spoken, that he considered the boilers on board a great many of our ships were a disgrace to the present state of science. When they found it to be the fact that the quantity of fuel consumed had decreased from an average of 5lbs. or 6lbs. to 2½lbs. per indicated h.p., he thought it showed a great amount of progress. That result might be obtained, not simply by having the best form of boiler, and the best mode of applying the fuel, but likewise by the perfection of the machinery which was driven. The measure was the fuel required, not to evaporate a given quantity of water, but to drive an engine of a certain power. That engine would be driven with the less steam, the more perfect was the machinery; therefore, the consumption of fuel was not only a test of the efficiency of the boiler, but also of the machinery which was driven by it. Undoubtedly, he agreed that the economical utilisation of fuel was one of the most important elements of progress in marine engines. There were two difficulties staring the engineer in the face—first, how to put the largest amount of available power on board a vessel of a given size; and, secondly, how to stow sufficient coal to make that power effective for a long voyage. In all long voyages, the period during which a vessel could run under steam was so limited that it was a matter of the greatest importance to make arrangements by which a supply of fresh fuel could be ensured at frequent stations. For his part, he believed the progress in the construction of boilers had kept pace with the improvements that had been introduced into steam machinery, and that our present boilers, so far from being a reproach to our engineers, were evidence that they had been as successfully occupied in this branch of manufacture as they had in the production of the most perfect machinery the world had ever yet seen. With respect to the twin screw system he was inclined to think if that plan had hitherto been the ordinary one for propelling vessels, and the single screw were introduced for the first time, we should be struck with the simplicity of the machinery required in the latter instance to produce the same results. In the statement of the work done by the twin screw ships, there was an omission of the speed obtained by each vessel; but in the table furnished by Messrs. Penn this information was given. The very feature by which alone we could judge of the real value of the twin system was omitted. The adoption of twin screws, it was to be remarked, involved a double risk of fouling, and if there was one difficulty more than another with regard to screw ships, it was the accidents which happened to the propellers from fouling with substances floating on the water, and certainly two small propellers were more likely to be injured in that way than one large one. Moreover, the hold of a vessel was better adapted for one pair of engines with one shaft and one screw, than for having all those parts duplicated, and consequently weaker and more liable to derangement. Although there might be advantages in this system for shallow waters and light draught, he believed where the screw was well immersed the single propeller was more effective. They could not but feel much indebted to Mr. Burgh for bringing this subject before them; whether connected with war or peace, with the navy or the merchant marine of the country, there was scarcely a question of equal importance to the nation. It was essential that we should have the best ships, the best boilers, and the best engines, to enable us to perform the longest voyages in the shortest time with the least amount of risk to the lives and cargoes conveyed.

Captain Symonds begged to state that there had been no instance recorded of the fouling of twin screws, and he believed they were far less liable to foul than the single screw.

The Chairman said, looking to the title of Mr. Burgh's paper, they must all agree that a very fair description had been given of what steam engines were in the year 1851 and of the improvements that had taken place since that time. To go into all the details of this subject would far exceed the limits of a paper; but, nevertheless, it had led to an interesting discussion, and in itself conveyed a great number of valuable details. The question of twin screws was perhaps the most important one that had been touched upon, and he agreed with Mr. Grantham that in an ordinary passenger and cargo, or mail ship, with considerable draught of water, the single screw would probably give as efficient results in speed and economy of power as the double screw; but where a great amount of power was required to be applied to a vessel of limited draught, as was the case with blockade runners, the double screw might do more than could have been done with a single one; and he would further express an opinion that in the manœuvring of ships of war in action, the double screw system no doubt conferred many advantages. He might remark that Captain Selwyn appeared to be a little mistaken with regard to the consumption of fuel. He understood Mr. Burgh to state that the consumption of coal had been reduced from 7 lbs. or 8 lbs. per indicated horse-power to as low as 2½ lbs. Perhaps the first was rather too large a figure as applicable to ten years ago; but his own impression was that the engines of good makers had worked with a consumption of not more than 1½ lbs. to 1¾ lbs. per indicated horse-power, which, compared with ten years ago, was a very great saving, and he thought our marine engineers ought to be gratified rather than otherwise that they had thus far succeeded in economising fuel. He now begged to propose a vote of thanks to Mr. Burgh for his interesting paper.

The vote of thanks having been passed,

Mr. Burgh acknowledged the compliment, and in reply upon the discussion, said he thought the advantages of the twin screw system were principally connected with the facilities for steering. With regard to the size of ship to which that system should be limited it was impossible to lay down any rule, because it must be borne in mind that it was more than probable that very heavy ordnance would be brought into use on ship board, so that very large vessels would become necessary, and then increased steerage power would be most valuable. The problem to be solved was whether the twin screw system admitted of universal application regardless of size and other conditions. Of that, he repeated, he required more evidence than had as yet been presented to him. With regard to the question that had been asked as to whether the accumulation of scale in the boiler had been prevented, he would say, if they used proper water in the boiler when they commenced working it, and if they took a sufficient supply of it to obviate the necessity of using dirty salt water, employing at the same time surface condensers, the scale in the boilers would be very greatly reduced. In reply to Mr. Wilson he would say, he thought the water was generally taken from the condenser, where but very little oil was presumed to be. Sometimes, it was true, in lubricating the internal portion of the cylinders, a certain portion of oil would get into the condensers, but not to an extent likely to prove injurious to the boiler.

At the conclusion of his remarks, Mr. Burgh explained the action of the equilibrium slide valve, and described the models and drawings lent by the several firms named in the paper, to whom the thanks of the Society are due.

Proceedings of Institutions.

Birmingham and Midland Institute.—The report of the Council, presented at the annual meeting, January 9th, says that although the Council are still unable to report the completion of the new buildings for the purposes of the free library and gallery of art, considerable progress has been made in their erection. They have received from Mr. Samuel Messenger a liberal offer of a pair of entrance-gates, after a design to be furnished by the Council. It is with sincere regret that the Council have to record the death, in March last, of Mr. William Oliver, who had acted as secretary of the Institute almost ever since its establishment, and who had so zealously fulfilled the duties of that office, as to earn the respect and esteem of all with whom he was brought into contact. The Council appointed as his successor, Mr. Edwin Smith, who had previously held the office of assistant secretary. Several valuable donations have been received during the past year, especially a spectroscope given by Mr. Pendleton, a former student in the industrial department. During the year thirty-two lectures have been delivered. Among these may be mentioned "Iceland and its Geysers," by the Rev. C. P. Wilbraham, Rural Dean of Newcastle; "History of Writing," by Mr. H. Noel Humphreys; "The Chemistry of Explosive Compounds," by Alfred Hill, Esq., M.D.; "The Grave and Gay in

Art, as exemplified in the Works of W. Blake, the Visionary, and George Cruikshank, the Humourist," by Sebastian Evans, Esq., M.A.; "The History of Gothic Window Tracery in England," by the Rev. T. N. Hutchinson, M.A., F.C.S.; "The Aymara Indians of Peru and Bolivia," by David Forbes, Esq., F.R.S.; "The Three Centenaries of Shakspeare," by Mr. Samuel Timmins; "Thackeray and his Works," by George Dawson, Esq.; "English Art in the days of Shakspeare," by Professor Chamberlain; "The Classification, Geographical Distribution, and Geological Relations of the Class Mammalia," four lectures by Professor Owen; "The Life, Character, and Oratory of Burke," and "The Life and Times of Washington," by C. J. Plumptre, Esq., Lecturer on Elocution at Oxford; "English Literature. The Anglo-Saxon Period," by the Rev. Alexander J. D. D'Orsey, B.D. The Council have been anxious to render this part of the operations of the Institute as interesting and attractive as possible. The attendance shows a progressive increase. The bequest by the late Sir Francis Scott of his valuable collection of Limoges enamels was mentioned in the last report. The pecuniary legacy which accompanied the bequest has enabled the Council to provide a fitting case for them, and they have been placed in the museum. The Council record with great gratitude the generosity of Lady Scott, who took upon herself the entire burden of the legacy duty on the bequest, so that the enamels passed to the Institute as a free gift. The Council also express their obligation to Professor Chamberlain for his very elegant and appropriate design for the case. It is a subject of regret to the Council that the very limited space at their disposal for the museum prevents the taking of any active steps for making any considerable additions to the collection. It is, no doubt, to the want of novelty arising from this cause that it is to be attributed a falling off in the number of visitors during the year. They have numbered only 1,229, as against 1,617 in 1863. The specification library has, during the past year, been more consulted than in any previous one. It has been visited by 705 persons in 1864, as against 626 in 1863, and 578 in 1862. In all probability, before the preparation of the next annual report, this valuable collection of books will be transferred to the walls of the free library. In the industrial department, the classes have been carried on with increased vigour and success. The aggregate number of students attending the classes by virtue of quarterly payments, has been, during the past year, as follows:—Winter term, 410; spring term, 377; autumn term, 530. These numbers do not include the classes to which the admission is by payment of one penny at the doors. These last-mentioned classes (which are chiefly composed of artisans) have largely increased. During the autumn term of 1864 the average attendance at the elementary arithmetic class has been 132; at the penny lectures, 100; at the elementary singing class, 118; making a total weekly average of 350. If this be added to the number of quarterly students it gives a total of nearly 900 persons receiving weekly instruction in connection with this department. Very marked success has attended the instruction, as tested by the public examinations, both by the Department of Science and Art and by the Society of Arts, a larger number of Institute students having entered the lists than in any previous year, and, while on the one hand the general average of success has been far higher than on any previous occasion, the number of failures has been less. An inaugural address was delivered by the Right Hon. C. B. Adderley, M.P., the president, at the opening of the session. It was stated in the last report that the sum of £81 3s. 2d. was required to free the Institute from debt. This has been paid through the generosity of William Scholefield, Esq., M.P., the president of the year, who kindly sent a cheque for that amount. The industrial department has been more nearly self-supporting than for several years past. The deficiency in that department amounts to £82 17s. 7d. In the general department there has been an excess of income over expenditure of £147 18s. 3d. The reports of the teachers in the various classes are most favourable.

DUBLIN INTERNATIONAL EXHIBITION.

His Royal Highness the Prince of Wales has announced his intention of opening the Exhibition on the 9th May.

The different foreign advices already received by the Executive Committee show that much progress is making to obtain interesting exhibits. In Canada, on the recommendation of Lord Monck, the Legislature has voted £1,000 for forming a small collection of articles. It is to include ores of copper and other metals; specimens of gold, slates, soapstone, chrome, iron, and serpentine marbles; samples of grains, hops, flax, maple sugar, and honey; sets of woods prepared for study or cabinet collections most useful in the arts, cabinet manufactures, &c.; articles of woollen manufacture, yarn and cloth, prepared skins and saddlery, implements, models, sets of newspapers and periodicals. A committee has been also formed in Sherbrooke, for forwarding a collection from the eastern townships of the province, on which Professor Miles, Lord Aylmer, Dr. Gilbert, and about a dozen other influential gentlemen, are acting.

The list of products sent on from Mauritius has come to hand, and includes specimens of the finest samples of sugar, for which the colony is famous, vanilla, a fine collection of fibres, woods, starches and grains, cigars and tobacco, matting, &c.

From Sierra Leone there will be fine collections of native products from different parts of Western Africa and the far interior, specimens of woods, the different kinds of trade beads in use, native jewellery, and other interesting articles which have been collected and shown at an industrial exhibition held in the island in February.

DIFFUSION OF ART AMONG THE MILLION.

The following recently appeared in the *Daily Telegraph*:—

When Wardour-street curiosity-shops advertise "articles of *vertu*," and critics glibly chatter about *art*, it is doubtful whether they know the solemn truth contained in the Franco-Latin and Anglo-Greek words which they employ. The Greek called the perfection of any result of human activity—the complete fitness of the means and manner to the end—its *aretë*, and the Latins imitated and adopted the idea in the word *virtus*; both expressions conveying the same meaning of "manhood," "maximum excellence," "absolute finish." Both words were intended to signify that true Art should be like to that Nature which it copies; as perfect in material, design, execution, and use as the workmanship of the Power whom these old races loved to call the "master workman." Providence "scamps" nothing, leaves nothing half-finished, nowhere shows a careless design, or a lost chance for service or beauty; the pearl of the poorest oyster-shell is as lustrously spread upon it as the silken light upon the lily-leaf. Infinite upwards and infinite downwards; passing beyond our telescopes and evading our strongest microscopes; eternal in range both ways, creation is always the same in perfection of design and admirable adaptation. There is a "common object" of the microscopist, for instance—the dust from the sea-bottom at Barbadoes. Examine it with the glass, and you are at once in a fairy ivory-turner's shop, gazing at millions of shells, every one as perfect for its inhabitant as the great conches that roll up upon the African beach. Trunk of elephant or lancet of mosquito, each is perfect in its way, each for its uses. Art, human art, has to imitate at a distance this Divine accuracy and adaptation, which give good work and true to everything they deal with. And human art can do it so far as it carries conscience, knowledge, and effort into its toil. We may take as the simplest possible example of "art"—of "vertu"—of excellence resulting from the humblest material and means—the water-pots of clay common to the East. They must carry much, with a narrow mouth; the handles must be sunk in the outline, to avoid accident; the price must be low, the substance strong; these are the conditions; and merely by complying with them in the *best possible* way, there has resulted a graceful traditional shape, which artists delight to import into their canvases, and cannot improve upon. Beauty has been silently and surely born out of the union of an earnest mind and a true hand, though the offspring is only a pipkin or jar. "Nothing common or unclean" should thus be the maxim of Art, as it is of the deepest philosophy. Everything has its "best"—its *vertu;* and everything is worth making of the best, and in the best manner, that is worth making at all.

These are platitudes! Unquestionably; but they are platitudes which were neglected almost universally among us within the memory of middle-aged men. "Art," to so recent a date as 1851, was with the million, and with a good many who looked down upon the million from the sublime heights of the "upper ten thousand," quite a different thing from the ideal to which we have referred. "Art" was merely painting a picture, chipping a statue, modelling a teapot, carving a table, casting a figure, weaving a carpet; and it hardly struck the general public of these realms that the teapot, table, and carpet had each a *virtue* of form, construction, and colour, to miss which was to miss much or all. In Science we have always been pre-eminent; no nation has a roll more glorious than that from which a hasty enumeration can at once recall such names as Newton, Priestley, Cavendish, Smeaton, Arkwright, Watt, and Davy. But the real Art-education of the country did not begin till 1851. It is not that we wanted the faculty, as events have shown; the appreciation of good work was always to be found among us. But we wanted the impulse, and it came at last, in the year when the productions of the world were grouped in the great Glass Palace. England saw then that she had neglected, ignored, misunderstood Art—the Art, we mean especially, which, so well comprehended and studied by the French, stoops to the utensils of the cottage and to the uses of daily household life. The good Prince who bore so valuable a share in promoting the first Exhibition lent his influence to its corollary, the establishment of Art-education in England. Schools of Art were founded in the country under the direction of the Committee of Council on Education; a national museum, for examples of just and perfect workmanship, was created at South Kensington. We "began at the beginning" with an effort to reform our "pots and pans," by classes and prizes for drawing and design; and amid a good deal of inevitable merriment at the first crude proceedings of "the Brompton boilers," the community set steadily to its task, with the help of the Government, to learn how its wealth of material and solidity of workmanship could be made richer and better by beauty of colour, form, and fashion.

An important minute, just issued to Parliament by the Lords of her Majesty's Privy Council on Education, communicates the welcome fact that the idea now "runs alone." The laughers and jokers swore it was rickety from its birth; that the grants and encouragements which were administered to it were so much wasted pap; that it wouldn't and couldn't thrive; and that common things were good enough to eat and drink, and live with, especially for common people. But now Art-education has taken such a lease of life in the country that its foster-parents find they can let it shift for itself. A select committee of the House of Commons, after examining the subject, has recommended that the Schools of Art should now rely on their own resources; and the directing department of the Privy Council accepts and adopts the view. To prove how the study has flourished a very few figures will suffice. In 1851 the Parliamentary grant to Schools of Art was £6,850, for seventeen schools and 2,482 students, showing an average cost of £2 8s. per student; while in 1863 the amount of subsidy was but £4,005, the schools being ninety and the students 16,180—in other words, each pupil "of the beautiful" stands us now only in the sum of four shillings and tenpence. The explanation is that manufacturers of every kind soon awoke to the existence of a native faculty for design, and that taste was an article no longer dispensed with or imported. Left to themselves, indeed, "my Lords" observe that they would not have withdrawn the grants just yet, and they object to curtail the indirect assistance which they extend to Art-education by the National Art School, or in prizes, studentships, and payments "by results." But the select committee is quite at its ease about the local schools, and they at least are henceforward to "run alone." The Council will still pay a grant for the night-classes of artisans, and also a capitation grant for children learning drawing; and we may remark that the grounds upon which they dissent from the proposal of the select committee to extend grants for adults seem sound. The child has to be brought to the study—the artisan must bring himself; and he will bring himself just in proportion as he sees it to his own benefit, and worth paying for from his own pocket. By the subsidy for children's drawing classes elementary instruction with pencil, pen, and crayon is put upon a distinct basis, and Parliament will be asked for a special vote for this useful purpose. The changes proposed do not affect the Kensington Museum, which will remain the central depository of Art examples, and which the Council very justly defends from extravagance, by showing that its treasures are natural possessions as well as educational machinery. We need not point out the satisfactory proofs of what Art-education, now firmly grounded, has done in the country; and what it will do would be difficult to exaggerate. It has removed true taste out of the connoisseur's cabinet into the poor man's reach, whence it will come back again throught all grades of society, for be it remembered that the poor man is the working man.

Fine Arts.

The Collegiate School of Strasbourg, in virtue of a bequest by M. Lamey, formerly Judge of the Civil Tribunal of that town, offers a prize of 3,000frs. for the best essay on the following theme:—"Should art be submitted to rules? On what do they rest? Are they absolute or relative, or partly one and partly the other? How is their authority to be reconciled with freedom of inspiration?" The prize is open to all the world, and the essays, which may be written in French, German, or Latin, are to be sent in by the 1st of January, 1867.

Industrial Art Education in Paris,—The *Union Centrale des Beaux Arts appliqués à l'Industrie,* lately established in Paris, has just commenced its first course of lectures. The session was opened with an address by the President, and a short lecture on Archæology by M. Adrien de Longpérier, of the Institut. The following is the list of the remainder of the course:—Four lectures on Architecture and Artistic Industry, by M. Daviond; three on Glass Painting, by M. Ferdinand de Lasteyrie; one on the Sanitary Condition of Industrial Artists, by Doctor Caffe; three on the Grammar of the Arts of Design, by M. Charles Blanc; two on Sculpture, by M. Aimé Millet; one on Light and Shadow, by M. Fouché; and three on Ceramic Works and their Ornamentation, by M. Albert Jacquemart. This Society, already referred to in these columns, has made arrangements for a grand exhibition of objects of artistic industry in the Palais de l'Industrie this year, and offered the sum of 300 francs, in two prizes, for models or designs for the medals to be given on the occasion. The effect was far greater than any one could possibly have anticipated No less than a hundred and forty-three designs and twenty-three wax models were sent in by seventy-nine candidates, and the society, surprised by the excellence of the works, doubled its grant, and gave two prizes in each class.

Public Monuments in France.—The labour, talent, and expense bestowed on the public establishments and monuments of the country have been enormous. Extensive restorations and decorations have been executed in the two great edifices of Notre Dame and Saint Denis, as well as in more than twenty churches in various parts of the Empire. The ancient Cité de Carcassonne, the Roman theatre and amphitheatre of Arles, the Château de Falaise in Calvados, the Temple of Diana, and the Roman Amphitheatre of Nimes, the Temple of Augustus and Livy at Vienne, the Abbey of Charlieu, in the department of the Loire, the Oratory of the Templars at Metz, the Chateau of Pierrefonds, the Château of Blois, the ramparts of Avignon, and other monuments of historic interest have been repaired. Of the public establishments, directly or indirectly connected with art, the building where the archives of the Empire are kept has been largely extended, and the School of Archæology annexed thereto has had a special building provided for it. The restoration of the Palace of the Institute has been completed; the arrangements of the new School of Fine Arts terminated; the old Château of St. Germain has been almost entirely restored, with the view of converting it into a grand museum of Gallo-Roman productions; the arrangements of the interior of the new Louvre have been pushed forward: a fine new gallery has been prepared for the works of the French School and thrown open to the public, a number of new rooms on both floors added to the gallery space in the new portion of the building, and several of the old rooms have been re-embellished and arranged at considerable cost; the corner building of the Tuileries by the river, known as the Pavillon de Flore, as well as a section of the grand picture gallery adjoining, have been completed as far as the masonry is concerned, and the whole of the remaining portion of the gallery has been levelled with the ground, and is now being rebuilt in the style of the adjoining work of Henry IV.; the reconstruction of the Bibliothèque Imperiale has been energetically pursued, and the new reading-room, modelled somewhat after that of the British Museum, is covered in, and will soon be ready for occupation; the famous manufactory of Sèvres has been entirely rebuilt; and the new Opera House has been carried up from the basement to the first floor. This is a long list, perhaps the longest list of such works that was ever furnished by a single Government, but it is far from complete, although it includes all the principal works connected with art which have been supported by the budget of 1864.

Statue in Honour of Teniers. — The King of the Belgians has ordered a bronze statue in honour of David Teniers, the founder of the Royal Academy of Antwerp, to be erected in one of the places of that town. The Government contributes 18,000 francs towards the work, which has been entrusted to Mr. Ducaju, of Antioch.

Pension to Mademoiselle de Puget.—The Emperor Louis Napoleon has granted a pension of 500 francs per annum to Mdlle. Fanny de Puget, the only surviving descendant of the famous sculptor of Marseilles.

The Ecoles des Beaux Arts not only in Paris, but throughout France, have been supplied with many models and casts from the antique, and copies of the works of the great painters. A class for the study of engraving on precious stones has been opened here, under the direction of M. Farochon. Pupils are admitted between the ages of fifteen and twenty-five. For foreigners the permission of the Minister of the Fine Arts is requsite.

Manufactures.

Exhibition of Arts and Manufactures for North Eastern London.—On Thursday, the 9th inst., a meeting of employers of labour and artisans interested in the manufactures of North Eastern London was held in the board-room of the Agricultural Hall Company, for the purpose of taking into consideration a proposal from the Provisional Committee of the North London Museum for a local exhibition of arts and manufactures during the ensuing autumn. The chair was taken by W. H. Bodkin, Esq., Assistant-Judge. The proposal was unanimously adopted, and also a resolution appointing a general committee of guarantors to make arrangements for carrying the same into effect. This movement is entirely unconnected with working men's industrial exhibitions, having solely for its object the promotion of the art-workmanship and manufactures of the district. The exhibition will consist of three distinct divisions—a manufacturers' department, an artisans' department, and a loan department. The guarantee fund asked for by the promoters of the exhibition is £2,000, of which about one-third was guaranteed by the meeting, and a considerable portion of the remainder promised.

Pneumatic Application of Ammoniacal Gas. — M. C. Tellier, whose proposed application of ammoniacal gas to locomotion was recorded in the *Journal* of the Society a short time since, now suggests a more simple application of the same substance, that of using it to create a vacuum, or partial vacuum, for industrial purposes, such for instance as the emptying of cesspools. The method proposed to be employed is to fill an iron receiver with the gas in question, and convey it to the spot where the vacuum is required. At the upper part of the receiver is a small reservoir containing water, and which communicates with the interior of the receiver by means of a stop-cock; when this is opened the water rapidly absorbs the gas, and the required vacuum is obtained. The quantity of water necessary for this purpose is said to be in the proportion of six or seven litres to a cubic metre of gas. In order not to lose the ammonia this is allowed to escape into another similar reservoir at the lower end of the receiver before the connection is opened between the interior of the latter and the cesspool. With this arrangement the total cost, in addition to that of the apparatus and the original supply of ammonia, would, according to M. Tellier, be reduced to the value of the coal required to disengage the gas from the solution, and this he estimates at four or five centimes the cubic metre. M. Tellier contemplates many applications of this principle, but the above will sufficiently illustrate his views.

Transformation of Napthaline into Benzoic Acid. —Two French chemists, brothers, announce the following method of transforming the residuum napthaline into benzoic acid. In the first place the napthaline is transformed into thallic acid, and afterwards into thallate of lime, and the latter is converted by heat into benzoic acid and carbonate of lime. The acid derived from napthaline has the same unpleasant odour as that obtained from the urine of herbiverous animals, and it is conjectured therefore that the agreeable odour of the same substance when derived from the gum is not normal but due to the presence of some foreign substance.

Liquid Glue.—The use of this substance has become very extensive in France, and it may be useful to give the process by which it is obtained. A kilogramme, 2¼lbs. avoidupois, of good glue of Cologne, or Givet, is dissolved in a litre of water in an earthen pot plunged in hot water, the water lost by evaporation being replaced. When the glue is completely dissolved, one fifth of a kilogramme of nitric acid at 30° centigrade is added; the acid throws the solution into a violent state of effervescence, and a quantity of reddish coloured gas escapes. When the mixture has become quiescent it should be well stirred, set aside to cool, and afterwards placed in well stopped vessels for future use.

Metallic Ceiling.—While all other departments in the internal decoration of houses have kept pace with improvements in other branches of industry, it is a somewhat remarkable fact, and one that has long engaged the attention of architects, that the ceilings of our rooms, with their unseemly blisters and network of cracks, are still, generally speaking, just what they were many years ago. Mr. Little has invented a system for the construction of ceilings, which consists in the application to the joisting of very thin stamped ductile metal, in ornamental embossed panels of such sizes and shapes as may be required, These stamped panels are fitted for every kind of decoration in colour, and if inserted as plain surfaces, may be used as the ground for every description of cartoon painting, combining with lightness and durability artistic and ornamental effect at a comparatively small cost. Besides its applicability to the ceilings of rooms, and all public buildings, churches, &c., the system may be made use of with the same effect in staircases, halls, and porticos, and even on the walls of rooms. It affords the means, when coupled with an iron framing, of making theatres fireproof, thus avoiding those sad contingencies to which these crowded buildings are so exposed.

Commerce.

SPIRITS AND WINE CONSUMPTION.—The average consumption of spirits, per head of the population, is shown by the following figures, for the last 60 years :—

	GREAT BRITAIN.		IRELAND.	
	Foreign and Colonial.	Home-made.	Foreign and Colonial.	Home-made.
	Gallons.	Gallons.	Gallons.	Gallons.
1800	0·31	0·531	0·09	0·257
1820	0·24	0·440	0·05	0·490
1840	0·22	0·787	0·04	0·907
1860	0·21	0·724	0·03	0·808

The wine consumption shows a gradual decline, which is not compensated by any very apparent increase in malt:—

	GREAT BRITAIN.	IRELAND.
	Gallons.	Gallons.
1800	0·46	0·28
1820	0·33	0·07
1840	0·34	0·09
1860	0·27	0·09

COTTON IN SIAM.—The *London and China Telegraph* says that special efforts have been made to increase the supply of cotton for the coming season. The profits to the cultivators on this important staple for the past two years have stimulated the people to give it greater attention, but with every possible effort it is not probable the increase can add more than one-fifth to the last crop. The cultivators are too few to expect more than that. According to the custom-house returns, 17,710 piculs have been exported during the year from Bangkok up to the 14th November, amounting to 2,334,339 lbs., and worth, at a moderate estimate, say 500,000 dols. The season (in mercantile language) is now over, but it is possible that the whole export for the year may reach 18,000 piculs.

BEET ROOT SUGAR IN FRANCE.—The beetroot sugar manufactured in France in September last amounted to 2,755,400 kilogrammes, in October to 38,847,910, in November to 44,832,875, in December to 35,476 845, and in January to 13.474,652, making for the five months 135,387,682 kilogrammes. Of this the sugar manufactories in the department of the North produced 50,618,237 kilogrammes, in the Pas de Calais 23,467,933 kilogrammes, in the Aisne 21,860,699, in the Somme 13,152,597, in the Oise 10,628,696, and in other departments 15,659,550 kilogrammes. There remained, moreover, in store of the preceding year's produce 13,828,243 kilogrammes. The consumption of beetroot sugar during the same five months amounted to 189,160,903 kilogrammes. The stock of beetroot sugar on the 31st of January last amounted to 87,470,079 kilogrammes, being 18,753,787 kilogrammes more than on the corresponding date of the year 1864. The number of sugar manufactories at present at work is 398, being 34 more than at this time last year. These returns are regarded as indicating that the beetroot sugar manufacture in France is prosperous.

THE VINE IN ALGERIA.—This cultivation has made great progress within these last few years. In the year 1862, the land planted with vines was estimated at 16,000 acres, of which 8,000 are situated in the provinces of Algiers, 5,500 in the province of Oran, and 1,500 in the province of Constantine. The vineyards produced in that year 43,222 hectolitres of wine, and 18,472,912lbs. of grapes were sold for the table. The land was chiefly planted with the Chasselas-Burgundy, Alicante, and Grenache vines. In 1863 additional plantations were made, both by the Arabs and colonists. The number of planters amounted to 27,281, of whom 22,300 were natives, and 5,000 Europeans. The vineyards covered 87,000 acres, of which 50,008 were planted with vines producing black, and the remainder with those producing white grapes. Of these vineyards, 10,500 acres are situated in the province of Algeria, which produced 83,000 hectolitres of wine, and 8,500,000lbs. weight of grapes for sale; 64,000 acres in the province of Constantine, producing 30,000 hectolitres of wine, and 4,100,000lbs. of grapes; and 12,500 acres in the province of Oran, producing 20,000 hectolitres of wine, and 2,000,000lbs. of grapes. The vines in the province of Constantine are newly planted, and do not as yet produce much wine.

EGGS.—From a recent Parliamentary return it appears that the annual importation of eggs into this country is at the rate of near one million daily.

COTTON SUPPLY.—The largest amount of cotton brought into this country for consumption was in 1860, when it amounted to 2,650,000 bales of 400 lbs. each. The total imports in Liverpool in 1864 were 2,247,755 bales, of which rather more than one-half were from India.

Colonies.

NATAL.—Of late years the coast lands of this dependency have been steadily opened up for the cultivation of sugar cane, coffee, tobacco, and other tropical products. The county of Victoria is separated from the seaport of Durban by the river Umgeni, which, although shallow enough during the dry winter months, is in the summer so deep and dangerous that it has been a formidable obstacle to traffic. While production and traffic were alike small the inconvenience entailed by such a troublesome stream was not felt to any material extent. In ten years, however, a great change has come over the country. There are now thirty sugar mills driven by steam at work in the colony. Last year about 4,000 tons of sugar were produced. Coffee and other plantations are springing up in all directions, and the Cotton Plantation Company has nearly 1,000 acres under cultivation. Hence has arisen the necessity for a bridge over the Umgeni, and the Queen's-bridge, which was recently opened, is an iron girder bridge, erected on cylinders, which rest on a bed of creosoted timber piling. There are seven spans, of about 100 feet wide each, and the bridge with its approaches is altogether about 1,100 feet long. The roadway is 20 feet wide and paved with asphalte. No other bridge in South Africa can at all vie with this either in size or appearance, and it is creditable to the young colony that it should have been accomplished, at a cost to itself of about £17,000, what the older provinces of the Cape have not yet contemplated.

North Australia.—An Australian paper says:—"If a colony could be established by Government *employés*, there would be no doubt as to the success of North Australia. It appears that many hundreds of young men, belonging chiefly to the middle class of this community, are quite ready to colonise the new country for the remuneration of five shillings per day. For this pay they are willing to bind themselves as labourers to do the rough work of the settlement in spite of aboriginal Malays, alligators, and tropical summers. This shows that the love of adventure is as strong here as in other parts of the world. Whilst, however, the two Government expeditions which have sailed are absolutely necessary to the establishment of the young colony, it must be borne in mind by the hundreds of persons who are looking with interest to North Australia, that the success of the enterprise must, after all, depend upon the efforts of individuals who go to occupy the country upon their own responsibility. A large extent of land has been sold, and it is fair to suppose that at least some of the purchasers will either become settlers themselves or will cause their property to be occupied by others. It is not to be expected that South Australia should supply the new country with any large number of settlers in addition to those who go there in the pay of the Government. In fact, the bulk of a population like ours would be as much out of place in North Australia as in India. Our labourers would be unsuited to the wet tropical summers of such a country, and would be unable to compete with the coolies and the Chinese who will come in thousands as soon as there are planters and other settlers ready to make arrangements for their immigration. But there is a way in which this colony could materially assist the new colony, that is, by persevering in the attempt to send stock overland. If this were successfully done, North Australia would almost immediately secure an export trade with Madras, Calcutta, Java, and Mauritius. The two last-mentioned countries are always ready to import horned cattle, whilst the Indian markets at the present time have to be supplied with horses from New South Wales and South Australia. The passage from North Australia to Madras or Calcutta would occupy about four weeks, and it is said that the vessels best suited to the trade would be those of about 300 or 350 tons burthen. September would be the proper time to ship horses for India, as they would then arrive there at the commencement of the cool season."

Barbadoes.—The shipments of produce last year were 36,108 hhds. sugar and 16,000 puns. molasses, against 42,000 hhds. sugar and 15,000 puns. molasses of the previous year. The cotton speculators also have cause to be satisfied, as their harvest, it is calculated, will realise 300,000 dols. return to the proprietors; and, what is more consoling again, this sum will be sure to be circulated in the island, the cotton being grown on small properties and sold on the spot. Here is no little advantage to reap from about 2,000 acres of land which hitherto were almost waste, giving little or no return. The sugar crop, this year, it is anticipated by some (of course the most sanguine) will reach 50,000 hhds. A steam plough has been successfully used on one estate, and the canes grown on this land are said to be of so superior a quality as to yield some three hogsheads to the acre.

British Guiana.—The quantities of produce shipped from the whole colony during the past year are as follows:—Sugar, 73,312 hhds.; rum, 26,053 puns.; molasses, 12,632 casks; timber, 816,812 feet; and cotton, 239 bales. The quantities shipped in 1863 were 77,105 hhds. sugar, 30,252 puns. rum, 5,704 casks of molasses, 408,769 feet timber, and 52 bales of cotton. There is an apparent falling off in the yield of sugar and rum as compared with the previous year's returns, but it is only apparent. The crop of last year largely exceeds that of the previous year, but from the want of shipping there is a large quantity of produce lying on hand; in fact, a larger quantity than has been found on hand at the same period in any previous year, and it will have to be brought into the current year's exports.

Public Works in New South Wales.—The opening of a branch railway from Blacktown to Windsor and Richmond, which took place on the 29th November last, was an event of much importance, not only on account of the benefit it has conferred upon a populous and fertile district, but also in relation to the question of railway communication in the colony. In order to lessen the cost of this railway, the works are much lighter in their character than those on the trunk lines. Should the new railway realise the expectations that have been indulged in, as to the suitability of the works to the nature of the traffic, the experience gained may be of value in the construction of future lines.—At Newcastle, progress is being made with the various works for the improvement of the harbour. The northern breakwater is being proceeded with; upwards of 1,200 tons of stone were deposited in November last. The ballast is supplied by vessels coaling at the port. Preparations are being made for the repair of the southern breakwater, which was damaged by gales. Along the greater portion of the new wharf the water has been deepened, and vessels drawing seventeen or eighteen feet of water can now go alongside. The steamers' wharf is completed, and plans are being prepared for a commodious goods shed to be erected close to it.

Salmon and Trout in Tasmania.—A favourable account has been received of the progress of both the salmon and trout in Tasmania, and Badger Creek, the locality chosen, appears admirably adapted for the salmon. The fish at present there are in good health and growing fast. The advisability of constructing a regular fish-hatching establishment at the place has been dismissed.

Publications Issued.

Le Monde de la Mer. By "Alfred Frédol." Royal 8vo. Paris (*Hachette*).

Le Ciel. By Amedée Guillémin, and

Les Plantes. By Louis Figuier (same form and same publishers).

Le Monde des Insectes. By S. Henri Berthoud. Royal 8vo. Paris (*Garnier, Freres*).

These represent a class of work which has only lately sprung up in France—popular expositions of scientific subjects, profusely illustrated. The most remarkable of the four whose titles are given above, is that which stands at the head. It is not signed by its author, but was the work of the late Moquin Tandon, of the Institut, a naturalist whose name would have stamped it with authority, but being written in a popular style, and not in scientific form, the academician used the pseudonym which he had often affixed to poetry and other miscellaneous works. He died while the sheets were going through the press. The work in question occupies more than six hundred pages, and all the products of the sea and its banks, from seaweed to white bears, are treated of in turn, and in a very interesting manner—scientific facts being intermingled with amusing anecdotes and remarks, and sometimes, it must be admitted, not quite according to English notions. The illustrations consist of twenty-one full sized chromo-lithographic plates, and two hundred illustrative cuts, of all sizes, on wood—all from the pencil of M. P. Lackerbauer. These latter are executed with great care and distinctness, and the peculiarities of the sea anemones and of the microscopic creatures of the ocean are given with rare fidelity; but the twenty-one coloured plates are really exquisite. M. Moquin Tandon's last work may not increase his high scientific reputation, but it will assuredly make his name known to thousands who never heard of it before, and would not otherwise have easily become acquainted with the wondrous creatures which he so lovingly and so agreeably describes.

The second book on the list is also a popular production by a highly scientific man, and, so far as the subject admits of it, it is illustrated with the same careful and profuse elegance. Like the preceding, the subject is treated with as great avoidance of technicalities as possible. Both these gentlemen acknowledge the assistance of their brother savans in various countries, and it is gratifying to see the names of Herschel, Gosse, and other Englishmen in the list. The other two treatises are by gentlemen well known as popularizers of science and pleasing writers, and they have performed their work in a very conscientious and agreeable manner. It would not be easy to find four other books in which knowledge is conveyed in a more pleasing style, or four volumes presenting higher qualities as regards typography and illustration.

Notes.

Southern Counties Association for the Encouragement of Agriculture, Arts, Science, Manufactures, and Commerce.—The second monthly meeting of the Council of the Association was held on the 7th inst., at the house of the Society of Arts. Present—the Marquis Camden (in the chair), Lord Viscount Sydney, Lord Viscount Eversley, Sir Henry Mildmay, Bart., G. Cubitt, Esq., M.P., G. Lyall, Esq., M.P., Lieut.-Col. Lennard, C. Wykeham Martin, Esq., Hon. and Rev. S. Best, Rev. J. Clutterbuck, and Messrs. Clutten, Spiers, Rigden, Whitehead, Simonds, Middleton, and Newton. After the transaction of the general business of the Council, the offer of the services of G. W. H. Shute, Esq., of Yateley, as secretary, were accepted. Sir W. Brook Bridges, Bart., M.P., and Major-Gen. the Hon. A. Hood were elected vice-presidents; and Wm. Deedes, Esq., of Sandling Castle, Wm. Wells, Esq., of Redleaf, Penshurst, and the Rev. John Goring, and P. S. Punnett, Esq., of Chart Sutton, added to the Council. A code of bye-laws was referred to a sub-committee, consisting of Lord Viscount Eversley, Colonel Lennard, Mr. Lyall, and Mr. Rigden, to report to the next meeting of the Council. After much consideration it was resolved that it would be impossible, before June, 1865, to make the necessary arrangements for the great annual exhibition of stock and implements proposed by the Association, but that the meetings for the second, third, fourth, and fifth departments of the Association—viz., natural history, local geology, botany, and horticulture, the second; the arts, manufactures, and commerce, as developed in these six counties, the third; local history and archæology, the fourth; and the improvement of the dwellings and the general condition of the labouring classes, the fifth—shall be held, and the times and places determined at the next Council. The Council was then adjourned to Wednesday, April 5, at two o'clock.

Renewal of Old Fruit Trees.—A French horticulturist has hit upon a curious mode of revivifying old fruit trees. He recommends that so long as the roots of the old trees are sound they should never be destroyed. His plan is, when the tree ceases to be productive, to cut it down to the neck of the roots and to insert two, three, or four grafts into the stump. This system he declares applicable to pear, apple, cherry, and almond trees. When the grafts have been put in, the face of the stump must be carefully covered with grafting wax or clay, and then the whole surrounded and covered up with mould, so that only one or two eyes of the grafts may be exposed. Six old pear trees were so treated on the 18th of March last; the grafts have attained from thirty to sixty inches in length, look very promising, and are expected to bear a good crop of fruit in three years. Where the roots of an old tree are well developed and sound, this mode of making use of them for a new family of small trees is certainly worth a trial.

Brome.—M. A. Lavallée, who has given much attention to the cultivation of the *Bromus schraderi* (referred to recently in the *Journal*), has just published a pamphlet on the subject,* giving an account of the experiences of himself and others with regard to this plant, its mode of cultivation, yield, influence in the production of milk, and chemical analysis. The main facts given are as follows:—The plant will yield two crops a year at first, and, in some cases, after the first year, three crops. A sandy soil seems best adapted for producing the grain of the plant; on damp land the seed is less abundant, small, and lighter. The yield, in some instances given, was as 74 to 1. The grain is exceedingly light, weighing little more than about two pounds to the gallon, or about half the weight of oats. After the sowing the ground is said to require no care whatever but simple rolling in spring. The soil should be turned up to a good depth previous to and heavily rolled after sowing; the latter point being much insisted on. If sown in March or April the first green crop may be cut in two months. The brome kills all the weeds that spring up with it. It is said to be the thickest-growing and cleanest crop known. The duration of the plant cannot yet be fixed, some in France are five years old, and are said to give no sign of failure, although five crops a year have been taken off it.

Climate of England.—At the Meteorological Society, Mr. Glaisher recently read a paper, in which he stated that the results of recorded observation showed that the character of the climate at the end of the last century was certainly very different from what it is now. Long continuance of frosts, and frequent and heavy falls of snow, are facts which can be recorded without instruments as well as with them. In the early period they were of more frequent occurrence than in the middle period of 30 years, and far more so than in the latest period. Thus the result, as formed by this comparison, without reference to instruments, and every investigation made all tend to confirm the accuracy of the indication found by instruments, viz., that our climate in the last hundred years has altered; that the temperature of the year is 2° warmer now than it was then; that in the month of January it is still higher; that the winter months are all much warmer; and that every month in the year seems to be somewhat warmer than before. The author remarked that this result was indeed important, if true, and he could not see how it was otherwise than true. Its effects will be to influence agricultural produce. New fruits may be introduced with advantage, and the character of our people will be altered.

Education in Russia.—The Russian government, as a consequence of the emancipation of the peasants, has taken measures for the diffusion of instruction among the agricultural population. An additional budget of 450,000 roubles for the year 1865 has been decreed, so that the budget of Public Instruction now amounts to about 1,300,000 roubles. This supplementary budget provides for the founding of village schools, of eleven new gymnasia (colleges), for the purchase of books, paper, &c., for the poorer peasants, for supplementary payment to schoolmasters and professors, for the purchase of scientific instruments, for the establishment of laboratories and museums, for the reorganisation of the University of Warsaw, for the foundation of a Polytechnic School, and for other schools for teaching agriculture and horticulture.

MEETINGS FOR THE ENSUING WEEK.

Mon. ...British Architects, 8.
Medical, 8.
Asiatic, 8.
Society of Engineers, 7. Discussion on Mr. Kock's paper "On Strength and Rigidity."
R. United Service Inst., 8½. 1. Commander F. P. Warren, R.N., "The Compositions for the Protection of Iron Ships' Bottoms from Fouling and Rust." 2. Mr. F. N. Gisborne, C.E., "His Anti-Fouling Composition for Iron Ships' Bottoms."

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* J. Rothschild, Paris.

Tues. ...Civil Engineers, 8. Discussion upon "Drainage of Paris" and "Metropolitan System of Drainage."
Statistical, 8. Professor Rogers, "On the Statistical and Fiscal Definition of the Word 'Income.'"
Pathological, 8.
Ethnological, 8. 1. Mr. Clements R. Markham, "On the Arctic Highlanders." 2. Dr. Rae, "On the Esquimaux."
Royal Inst., 3. Prof. Masson, "On Recent British Philosophy."
Wed. ...Society of Arts, 8. Mr. G. C. Steet, "On the Preservation of Food, especially Fresh Meat and Fish, and the best form for Import and for Provisioning Armies, Ships, and Expeditions."
Geological, 8.
London Inst., 7.
R. Society of Literature, 4½.
Archæological Assoc., 8½.
Thurs. ...Royal Inst., 3. Professor Masson, "On Recent British Philosophy."
Philosophical Club, 6.
Antiquaries, 8.
Royal, 8½.
Fri. ......Royal United Service Inst., 3. Mr. Benjamin Sharp, "The Comparative Merits of Smooth-bore and Rifle Ordnance when employed at Sea, and on the Proper Armament for Ships of War."
Royal Inst., 8. Professor Westmacott, "How Works of Art should be looked at."
Sat. ......R. Botanic, 3¾. Prof. Marshall, "On the Nervous System.

PARLIAMENTARY PAPERS.

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SESSIONAL PRINTED PAPERS.

Par. Numb. *Delivered on 28th February*, 1865.

3 (121 to 130). Railway and Canal, &c. Bills—Board of Trade Reports, Parts 121 to 139.
26. Tewkesbury Borough Magistrates—Correspondence.
64. Navy (Shipbuilding Works)—Programme.

Session 1864.

546. Army, &c. (Clothing)—Return.
554. Local Government Act (1858)—Sixth Annual Report.

Delivered on 1st March, 1865.

22. Bill—Public House Closing Act (1864) Amendment.
3 (140 to 152). Railway and Canal, &c. Bills—Board of Trade Reports, Parts 140 to 160.
8. Poor Relief (Scotland)—Return.
29. Battersea Charities—Report of Inspector.
67. East India (Army and Police)—Returns.
76. Bullion—Return.
Census of Ireland (1861), Part V.—General Report.

Session 1864.

568. Population and Revenue—Return.

Delivered on 2nd March, 1865.

40. Bills—Affirmations (Scotland).
43. ,, Sheep, &c. Protection, (Ireland).
3 (154 to 173). Railway and Canal, &c. Bills—Board of Tra Reports (Parts 154 to 163).
66 (II.) Railway and Canal, &c. Bills—Third Report of Gener Committee.
Life Annuities—Regulations respecting Government Insurances
Unmalted and Malted Barley—Preliminary Abstract Report o Experiments.

Delivered on 3rd March, 1865.

44. Bills—Inns of Court.
45. ,, British Kaffraria (amended).
3 (153). Railway and Canal, &c. Bills—Board of Trade Report Part 153.
3 (174 to 182). Railway and Canal, &c., Bills—Board of Trade Reports, Parts 174 to 182.
34. Metropolitan Board of Works—Account in Abstract showing the receipt and Expenditure, &c.

Delivered on 4th and 6th March, 1865.

46. Bills—Church Attendance.
47. ,, Metropolitan Toll Bridges.
48. ,, Writs Registration, &c. (Scotland) (No. 2).
49. ,, Herring Fisheries (Scotland).
3 (183 to 206). Railway and Canal, &c. Bills—Board of Trade Reports, Parts 183 to 206.
13. Soldiers' Trades—Return.
53. Revenue and Trade (Ireland)—Abstract.
61. Army Estimates—Statement.
65 (II.). Committee of Selection—Third Report.
69. Patriotic Fund—Fifth Report of Royal Commissioners.
72. Army and Militia (Flogging and Marking)—Returns.
81. Mary Ryan—Official Correspondence.
86. Education—Returns.
88. Malt—Return.
93. Civil Services (Scheldt Toll Redemption)—Supplementary Estimate (Class 7), Vote 12.
100. Piers and Harbours (Provisional Orders)—Board of Trade Report.
New Zealand—Further Papers.

Delivered on 7th March, 1865.

47. Bills—Metropolitan Toll Bridges (a Corrected Copy).
50. ,, Private Bill Costs (as amended by the Select Committee.)
3 (207 to 227). Railway and Canal, &c. Bills—Board of Trade Reports, Parts 207 to 237.
57. National Debt—Account.

Patents.

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From Commissioners of Patents Journal, March 10*th*.

Grants of Provisional Protection.

Aeriform fluids, motive power from—501—M. P. W. Boulton.
Beer, &c., brewing, fermenting, &c.—2719—C. Garton and T. Hill.
Bottles, jars, &c., stoppers for—27—N. Thompson.
Buoys, beacons, &c.—387—C. Atherton and A. H. Renton.
Cabinet, sofa, and chair-bedsteads—476—A. Sharp.
Caoutchouc, manufacture of—398—P. A. Le Comte de Fontaine-Moreau.
Coats and capes, waterproof—471—C. D. Barge and A. Hermant.
Dough, apparatus for working—483—J. H. Johnson.
Escapement, application to clocks of a circular—462—P. E. Bidaux.
Filtering apparatus—249—V. Burg.
Fire-arms—425—B. Thompson.
Fluids, apparatus for raising and forcing—410—J. Gresham.
Furnaces—443—E. B. Wilson.
Globes or shades—2791—M. A. F. Mennons.
Hay, cotton, &c., construction of presses for—3294—H. A. Bonneville.
Iron, machinery for rolling and hammering—375—J. Ramsbottom.
Lawn mowing machines—458—J. B. Brown.
Liquids, obtaining power from—2770—C. Garton.
Looms—494—J. Dodgeon, J. Gaukroger, and W. Shackleton.
Mashing machines—481—R. Willison.
Mineral oils, extracting gases from—344—W. Sim.
Motor, mercuro hydraulic—492—R. A. Brooman.
Ordnance, &c., manufacture of—295—J. H. Johnson.
Puddling furnaces—473—J. G. N. Alleyne.
Reaping machines—384—D. H. Barber.
Shifting wrenches—457—W. Clark.
Ships afloat, examining, cleaning, and repairing the bottoms of—105—R. F. Moll.
Steam engines—338—C. Lungley.
Stopping bottles—464—J. J. Chidley.
Tanning leather—2704—W. Smith.
Ventilating blinds—443—C. Lungley.
Weights, use of magnets in overbalancing—461—T. P. Tregaskis.
Zinc, products obtained when coating iron with—469—J. Graham.

Inventions with Complete Specifications Filed.

Crinolines, covered steel for—588—W. S. Thomson.
Clothing, covered springs for—623—T. S. Sperry.

Patents Sealed.

2239. B. Glover.
2274. C. Brown.
2323. S. Laing.
2331. E. R. Handcock.
2362. W. Clark.
2453. T. Brown.

From Commissioners of Patents Journal, March 14*th*.

Patents Sealed.

2260. J. H. Simpson.
2275. M. D. Jeffreys.
2277. R. Chrimes.
2280. J. Adams.
2283. R. Richards.
2288. J. Smith.
2294. R. A. Brooman.
2295. R. W. Sievier.
2298. W. Lawrence.
2305. W. Clark.
2309. H. Rogers.
2314. J. L. Courcier.
2327. I. Watts, jun.
2335. B. W. A. Sleigh.
2338. W. B. Woodbury.
2339. W. Palmer, jun.
2340. J. H. Kidd & J. C. Mather.
2344. H. Bridgewater.
2374. J. C. Wilson.
2376. H. and H. Forbes.
2404. W. F. Henson.
2431. G. T. Bousfield.
2445. C. Greenway.
2548. W. E. Newton.
2623. W. Richards.
2970. R. Maynard.
2995. T. Harris.
123. A. V. Newton.
152. W. E. Newton.
200. W. E. Newton.

Patents on which the Stamp Duty of £50 has been Paid.

617. T. H. Wood.
658. C. Hall.
893. J. P. Woodbury.
667. W. H. & F. C. W. Latham.
782. D. E. Siebe.
647. J. B. G. M. F. Piret.
648. J. T. Calow.
723. G. Hamilton.
929. G. and J. Collier.
671. W. Conyers.
652. J. Nadal.
689. E. T. Hughes.
810. T. White.

Patents on which the Stamp Duty of £100 has been paid.

492. G. T. Bousfield.
529. A. Wallis and C. Haslam.
532. D. Gallafent.